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Introduction

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- Scientific and technical reports of government agencies, universities, and research organizations throughout the world.

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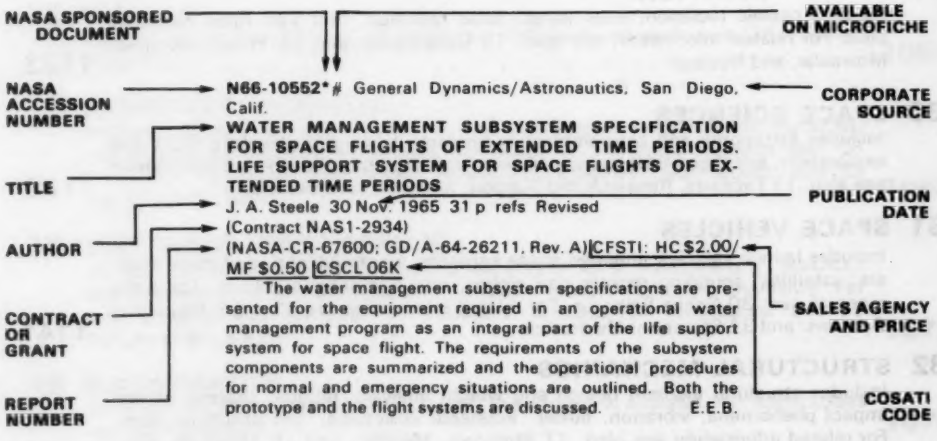
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N66-10552* # General Dynamics/Astronautics, San Diego, Calif.
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TITLE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
PUBLICATION DATE
AUTHOR
J. A. Steele 30 Nov. 1965 31 p refs Revised
(Contract NAS1-2934)
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REPORT NUMBER
(NASA-CR-67600; GD/A-64-26211, Rev. A) CFSTI: HC $2.00/ MF $0.50 CSCL 06K
SALES AGENCY AND PRICE
The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed. E.E.B.
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VOLUME 4 NUMBER 7

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N66-16225# Aeronautical Research Council (Gt. Brit.)
DESIGN OF WARPED SLENDER WINGS WITH THE ATTACHMENT LINE ALONG THE LEADING EDGE
J. Weber London, HMSO, 1965 43 p refs Supersedes RAE-TN-AERO-2530, ARC-20051; See N65-20495
(ARC-R&M-3406; RAE-TN-AERO-2530; ARC-20051) HMSO: 15s 6d

This report deals with the design of slender warped wings with unswept trailing edge but otherwise arbitrary planform which have, at the design lift coefficient, zero load along the leading edge and a near planar vortex sheet from the trailing edge. The wing can have an arbitrary chordwise curvature on which a spanwise curvature is superposed so that in any spanwise section the wing is straight over the inner part of the wing and curved over the portion near to the leading edges; the position of this change can vary arbitrarily in the chordwise direction. Formulae and working charts are given for determining the local load coefficient (and with it the streamwise velocity component), the spanwise velocity component, the total lift coefficient and the total drag. Numerical examples, for the gothic planform, are given to illustrate some of the effects of the various parameters on the load distribution, the section shapes and the drag. Slender-wing theory has been applied except for determining the wave drag which has been obtained from an approximate relation derived by the not-so-slender theory of Adams and Sears. Author

N66-16422# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
LINEAR DYNAMIC ANALYSIS OF THE SPINNING AXISYMMETRICAL ROCKET OR VEHICLE
Akira Azuma Dec. 1965 66 p refs
(Rept.-399, Vol. 30, No. 8) CFSTI: HC $3.00/MF $0.75

This report contains a dynamic analysis of the angular behavior of a spinning body flying either in vacuum or in atmosphere. The study is mainly concerned with the angular motion of a rigid axisymmetrical body having a thrust misalignment and another moment due to the deflection of control surfaces or control jets. In linear feedback system which is used in the control of spin-stabilized space vehicle, preferable combinations of the control parameters, such as feedback gain, spin rate, feedback phase difference and damping of the system, are obtained to optimize the stability and control of the vehicle. In the case of asymmetrical feedback system the linear approximate solution has been obtained. The analysis of the feedback system will be applied to the motion of either launching or reentry vehicle within atmosphere. Author

N66-16431# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
THE BEHAVIOR OF THE WAVE DRAG COEFFICIENT OF A CERTAIN OPTIMUM BODY IN OFF-DESIGN CONDITIONS
H. I. Baurdoux and P. J. Zandbergen 8 Oct. 1964 25 p refs
(NLR-TN G.33) CFSTI: HC $1.00/MF $0.50

In this report the drag-coefficient of an optimum body with a conical nose has been determined. The body was designed for a Mach number of the undisturbed stream equal to 3. It is found that the curve for the drag coefficient shows a definite kink at the design Mach number. The conclusion is reached that a more general approach for designing optimum bodies will lead to lower values of the wave drag than those obtained by applying current theories. Author

N66-16488# Aeronautical Research Council (Gt. Brit.)
WIND TUNNEL TESTS AT MACH NUMBERS UP TO 2.80 TO DETERMINE THE EFFECTS OF CHANGING SPANWISE VOLUME DISTRIBUTION ON SLENDER, CAMBERED OGEE WING
T. A. Cook London, HMSO, Aug. 1964 23 p refs Supersedes RAE-TN-AERO-2975, ARC-26701
(CP-804; RAE-TN-AERO-2975; ARC-26701) HMSO: 4s 6d

Tests were made at M = 0.31, 1.40 (0.20), 2.40, and 2.80 to examine the effects of concentrating volume near the centerline of an integrated, slender configuration. The results show that the effects of changing spanwise volume distribution are generally small, though skin friction drag is affected by changes in wetted surface area. Author

N66-16561*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF NOSE-MOUNTED CONTROL-SYSTEM JETS IN ROLL-CONTROL POSITIONS ON THE AERODYNAMICS OF A SPACE VEHICLE
John T. Suttles and Robert L. James, Jr. Washington, NASA, Feb. 1966 28 p refs
(NASA-TN-D-3282) CFSTI: HC $2.00/MF $0.50 CSCL 01A

A wind-tunnel investigation has been conducted to determine the effect of jets produced by a nose-mounted solid-rocket control system on the aerodynamics of a two-stage rocket vehicle. The configuration tested was a 0.10-scale model of a NASA flight research vehicle consisting of a first stage composed of a fin-stabilized booster with two auxiliary rockets and a second stage composed of a rocket motor with a spacecraft compartment mounted on its forward end. The solid-rocket control system is housed within the spacecraft compartment. This configuration was tested in the wind tunnel by exhausting cold air from simulated control-rocket nozzles. The tests were conducted for the roll-control mode at a Mach number of 2.80 with variations in the angle of attack and the jet-to-free-stream pressure ratio. The results of this investigation indicate that significant aerodynamic effects are obtained when the control system is used in conjunction with downstream fins and auxiliary rockets. It was found that use of the roll-control mode for this configuration could result in a sizeable loss of control power; in addition, it was found that a small reduction of static stability was obtained. Author

N66-16562*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF NACELLE ORIENTATION ON THE AERODYNAMIC CHARACTERISTICS OF AN ARROW WING-BODY CONFIGURATION AT MACH NUMBER 2.03
Emma Jean Landrum Washington, NASA, Feb. 1966 14 p refs
(NASA-TN-D-3284) CFSTI: HC $1.00/MF $0.50 CSCL 01A

The investigation was performed in the Langley 4- by 4-foot supersonic pressure tunnel at a Reynolds number based on the wing mean aerodynamic chord of 4.05×10^6. The wing had a design lift coefficient of 0.08, a leading-edge sweep angle of 70°, and an aspect ratio of 2.24. Tests of each of three wing-body-nacelle configurations were conducted through an angle-of-attack range from −4° to 6° for nacelle alinement angle from −4° to 6°. Sidewash angles at the nacelle locations were measured through the angle-of-attack range and are compared with theoretical estimates. The minimum incremental drag due to a nacelle or a combination of nacelles occurs at or near a nacelle alinement angle one-half the sidewash angle or one-half the average sidewash angle, respectively. Addition of the nacelles has little or no effect on the lift-curve slope, the slope of the curve of the pitching moment with respect to lift, or the drag due to lift. Author

N66-16563*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLOW FIELD SURVEY AND DECELERATOR DRAG CHARACTERISTICS IN THE WAKE OF A MODEL OF THE X-15 AIRPLANE AT MACH 2.30 AND 4.65
James F. Campbell Washington, NASA, Feb. 1966 37 p refs
(NASA-TN-D-3285) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The four types of decelerators tested were as follows: self-inflatable (ram-air) ballute, supersonic parachute, rigid cone, and rigid tension shell. A pressure survey was also included at Mach numbers of 2.30 and 4.65 to define the X-15 wake characteristics. Decelerators are available that will produce stable characteristics behind the X-15 airplane and with relatively high drag characteristics, even though the X-15 has asymmetric wake characteristics. At trailing distances on the order of 7 to 10 times the towing-model base diameter, the 80° rigid cone had the highest value of drag coefficient of all the decelerator configurations investigated. Both the rigid tension-shell configuration and the supersonic parachute configuration were extremely unstable at longitudinal distances downstream of the towing-vehicle base greater than 4.5 and 6.7 base diameters, respectively; however, the tension-shell configuration indicated a potentially high drag capability. Author

N66-16589*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF LEADING-EDGE BLUNTNESS AND RAMP DEFLECTION ANGLE ON LAMINAR BOUNDARY-LAYER SEPARATION IN HYPERSONIC FLOW
James C. Townsend Washington, NASA, Feb. 1966 26 p refs
(NASA-TN-D-3290) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Leading edge bluntness effects on the characteristics of laminar boundary layer separation induced on a flat plate by a trailing edge ramp were investigated in a 15-inch hypersonic flow apparatus. Three leading edge radii and five ramp deflection angles (0 to 40°) were tested on the plate at a Mach number of 10.03 and nominal Reynolds numbers of 1.26×10^5 and 1.56×10^5 per inch. Tests were made at zero angle of attack, and end plates were used to approximate two-dimensional flow conditions. Results indicate that at a Mach number of 10.03 there are considerable effects of leading edge bluntness on the flow separation characteristics. The pressure rise through the interaction region to the pressure plateau is much less and the extent of the separation region is much smaller with the 0.102-inch nose radius than with the sharp nose radius (less than 0.001-inch) for each ramp deflection angle. The pressure rise and the length of the separated flow region are reduced by more than one-third for the higher ramp angles. A further increase in the nose radius to 0.203-inch produces only small changes in the pressure distribution and in the extent of the separation region. R.N.A.

N66-16612# Cincinnati Univ., Ohio
EXPERIMENTAL INVESTIGATIONS OF HYPERSONIC FLOW AROUND TWO-DIMENSIONAL CIRCULAR CYLINDERS Interim Technical Report, Oct. 1963–Jun. 1964
K. H. Token and H. Oguro Wright-Patterson AFB, Ohio, ARL, Oct. 1965 38 p refs
(Contract AF 33(616)-8453)
(ARL-65-212; AD-625384) CFSTI: HC $2.00/MF $0.50

The paper describes an experimental investigation of the flow phenomena about a two-dimensional circular cylinder in a hypersonic stream. The purpose of the investigation was to record properties of the flow regions which have a direct effect on the wake behind a two dimensional circular cylinder. All data were obtained at a nominal Mach number of 14 and a stagnation temperature of 1800R. The total pressure settings were between 600 and 2000 psia, although the majority of the data was taken at 1000, 1200, 1400, or 1600 psia. Model diameters varied from 1/4 to 3/4 inch, however tests about 3/8 and 1/2 inch diameter models were most common. Data concerning pressure distributions at the body, in the base flow region and near wake were obtained. In addition, some qualitative results were obtained with the hot wire anemometer at the body surface. Author (TAB)

N66-16616# Cincinnati Univ., Ohio. Hypersonic Aerodynamics Research Staff.
EXPERIMENTAL AND ANALYTICAL STUDIES IN CONTINUUM HYPERSONIC FLOW Final Report, 1 Jul. 1964–30 Jun. 1965
Ting Yi Li Wright-Patterson AFB, Ohio, ARL, Sep. 1965 27 p refs
(Contract AF 33(616)-8453)
(ARL-65-183; AD-625205) CFSTI: HC $2.00/MF $0.50

The analytical studies in continuum hypersonic flow carried out are reviewed and summarized in the present report. Also summarized is the progress made in the originally envisaged investigation of torsion-rod flexures for dynamic stability tests in hypersonic wind tunnels. The theoretical studies include investigations into inviscid hypersonic flow, hypersonic viscous-inviscid interaction, and binary boundary layer flows. Author (TAB)

N66-16624# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
AERODYNAMIC PERFORMANCE OF REVERSED FLOW VORTEX CHAMBERS
Robert Poplawski and Alfred C. Pinchak Oct. 1965 82 p refs
(ARL-65-219; AD-625405) CFSTI: HC $3.00/MF $0.75

This work presents recent experimental results obtained with unconventional vortex tubes. Experiments were conducted in both the compressible, supersonic and incompressible flow regimes. By proper injection of the fluid a reversed secondary flow pattern is obtained which enhances particle or gas separation processes. The aerodynamic performance of these new vortex or swirl chambers is compared with the data of other investigators employing conventional vortex chambers. A detailed account of the experimental procedures, both successful and unsuccessful, is also included. Secondary flows in both conventional and in the aforementioned swirl chambers are discussed in some detail. Consideration is also given to the factors limiting the maximum rotational velocities obtainable in vortex tubes. TAB

N66-16655# Cincinnati Univ., Ohio. Coll. of Engineering.
CALCULATION OF THE FORCE COEFFICIENT FOR DELTA WINGS IN HYPERSONIC FLOW Interim Report, Apr. 1964–Jun. 1965
Arnold Polak Wright-Patterson AFB, Ohio, ARL, Sep. 1965 43 p refs
(Contract AF 33(616)-8453)
(ARL-65-182; AD-625404) CFSTI: HC $2.00/MF $0.50

The results of the Newtonian theory as applied to a delta wing at moderate angles of attack in hypersonic stream are used to calculate the pressure coefficient by the inverse method in a closed form. Author (TAB)

N66-16924*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A FLAPPED TILT-WING FOUR-PROPELLER V/STOL TRANSPORT MODEL
Kenneth W. Goodson Washington, NASA, Feb. 1966 110 p refs
(NASA-TN-D-3217) CFSTI: HC $4.00/MF $0.75 CSCL 01A

An investigation of the aerodynamic characteristics of a 1/11-scale model of a four-propeller tilt-wing V/STOL transport configuration has been conducted. Tests were made of the model through the transition-speed range for various combinations of wing tilt angle and thrust coefficient using propellers having a blade pitch of 12°. Some tests were made in ground effect. Tuft studies indicate that flow separation occurs at descent angles of about 6° at some transition speeds. The descent capability, therefore, should be at least 6° and may be greater depending on the intensity of buffet encountered on the actual aircraft. Considerable improvement in descent capability was obtained by extending and drooping the leading edge of the wing or by using a lower propeller-blade pitch angle of 8°. Author

N66-17017# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ANALYSIS OF THE RESULTS OF INVESTIGATIONS OF A MODEL TURBINE STAGE USING COMPUTERS
R. Puzyrewski and T. Jankowski 24 Nov. 1965 15 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 10, 1964 p 17–20
(FTD-TT-65-1026/1+2+4; AD-624836) CFSTI: HC $1.00/MF $0.50

A solution is given to the problem of determining the characteristics of cascades (ϕ, ψ, and outer angle) from experiments on a model turbine stage. Author (TAB)

N66-17033# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN RESULTS OF INVESTIGATION OF A CENTRIPETAL GAS TURBINE WITH NOZZLE ADJUSTMENT
A. I. Loshkarev and B. N. Bryukhanov 18 Nov. 1965 27 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), no. 2, 1963 p 208–223
(FTD-MT-64-455; AD-624767) CFSTI: HC $2.00/MF $0.50

Questions concerning the selection of parameters for a projected centripetal turbine are considered. The influence of twisting at the outlet from the rotor on the possibility of increasing the developed temperature drop is considered. Also, efficiency and power losses are discussed. E.E.B.

N66-17121# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF VERTICAL WIND GUSTS ON THE BASIS OF OSCILLATIONS OF AIRCRAFT IN FLIGHT WITH THE PILOT'S ACTION ON CONTROL LEVERS TAKEN INTO ACCOUNT
A. S. Dubov 18 Nov. 1965 29 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. Vopr. Chislennogo Prognoza i Analiza Meteorol. Poley (USSR), Issue 121, 1961 p 109–124
(FTD-MT-64-437; AD-624759) CFSTI: HC $1.00/MF $0.50

In the data of registration of elements of disturbed longitudinal motion of an aircraft in a specific flight there are calculated values of the vertical wind velocities. The calculations are made on the basis of different variants of approximate formulas with and without taking into account the pilot's counteraction to the dynamics of the flight. A comparison of results is made and a conclusion on the role of various factors and the accuracy of variants of the calculation is made. Author

N66-17265*# Thiokol Chemical Corp., Ogden, Utah. Astro-Met Div.
A DIGITAL COMPUTER SIMULATION OF HIGH ALTITUDE PARACHUTE RESPONSE TO WIND GRADIENTS
Robert L. Ammons 23 Jun. 1965 146 p refs
(Contract NAS1-4537)
(NASA-CR-66045) CFSTI: HC $4.00/MF $1.00 CSCL 01A

The response of two parachute systems—impervious hemisphere and disc-gap-band—was studied as a function of wind shear and altitude. Both systems were simulated on a digital computer as rigid bodies. The computer program included the effects of Magnus forces and viscous damping. Equations for a parachute falling in a wind field at 0° angle of attack are presented, as is a technique for determining error as a function of altitude on either parachute. The computer program dynamic model and equations of motion are summarized, and all computer data outputs are supplied. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N66-16476# Boeing Co., Morton, Pa. Airplane Group.
FEASIBILITY STUDY OF ON-SITE FABRICATED HELICOPTER PADS Progress Report, May–Sep. 1965
J. G. Mc Ewan Nov. 1965 79 p refs
(Contract NOw-73258)
(D6-57117; AD-623953) CFSTI: HC $3.00/MF $0.75

The on-site fabrication of helicopter pads using plastic resins and other lightweight materials was investigated. It was assumed that rapid curing materials could be sprayed or poured over soil, resulting in a surfacing of sufficiet strength to allow the operation of helicopters on low California Bearing Ratio (CBR) soils. Materials were sought which had desirable characteristics such as rapid curing under wide temperature and moisture conditions, low cost, low toxicity, high strength-to-weight ratio, easy application, and extended storage life. Forty-three materials were evaluated. Materials which did not cure within a prescribed 3-hour limit were eliminated from further structural testing. Twenty materials were subjected to small-scale structural testing. Of these materials, three polyester resins, one epoxy resin, and one polyurethane foam exhibited the highest strength characteristics. Static wheel-load tests of 14,000 pounds and 80 psi tire pressure were performed, simulating the CH-37C marine helicopter wheel loading. (a) All polyester reinforced with 17 to 35 percent chopped fiberglass withstood the 14,000 pound wheel load. (b) One epoxy specimen reinforced with 32 percent chopped fiberglass withstood a 14,000 pound wheel load. (c) One polyurethane foam specimen with an 18 pound per cubic foot density and an average thickness of 1 inch failed at a 3700 pound wheel loading. TAB

N66-16504# Army Aviation Materiel Labs., Fort Eustis, Va.
UH-10 AIRCREW ARMORED SEAT CRASH SURVIVAL ANALYSIS Preliminary Report
J. L. Red and H. W. Holland Aug. 1965 49 p
(USAAVLABS-TR-65-59; AD-624119) CFSTI: HC $2.00/MF $0.50

This report contains the results of preliminary crash survival analyses of a UH-1D helicopter aircrew armor seat. The data used in this study were developed from manufacturers' drawings, military specifications, and other sources. Further effort is required to determine the quantitative effects of the incorporation of an aircrew armor system into the existing UH-1D seat frame and restraint system. However, preliminary analyses and tests indicate that the new system, as configured, will contribute to a marginal crash survival condition for the aircrew occupants. Therefore, a program of redesign should be given serious consideration. Author (TAB)

N66-16615# Stevens Inst. of Tech., Hoboken, N. J. Davidson Lab.
THE EFFECT OF WAVES, LOADING, AND CONFIGURATION ON THE TAKE-OFF PERFORMANCE OF WATER-BASED AIRCRAFT
Robert Van Dyck Nov. 1964 40 p refs
(Contract NOw-62-0728-d)
(R-1031; AD-625368) CFSTI: HC $2.00/MF $0.50

A model investigation was undertaken to define the effects of waves, loading, and hydrodynamic configuration on the overall take-off performance of waterbased aircraft. Complete take-offs were made using dynamic models towed at constant thrust in calm water and in regular waves. Performance is evaluated by means of the average resistance-to-gross-weight ratio obtained from the time-distance-velocity measurements made during take-off. At a given loading, average resistance increases in proportion to wave height for take-offs made in wavelengths on the order of twice the hull length. Curves are presented showing the effects of loading, and comparisons are made between the different configurations tested. The model data show trends generally similar to those of available full-scale take-off results, when take-off time and distance are properly defined. Author (TAB)

N66-16671# Systems Technology, Inc., Hawthorne, Calif.
AN ANALYTICAL STUDY OF V/STOL HANDLING QUALITIES IN HOVER AND TRANSITION
R. L. Stapleford, J. Wolkovitch, R. E. Magdaleno, C. P. Shortwell, and W. A. Johnson Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1965 172 p refs
(Contract AF 33(615)-1300)
(TR-140-1; AFFDL-TR-65-73; AD-625599) CFSTI: HC $5.00/MF $1.00

The hover analysis considers pilot attitude and position control tasks in the presence of horizontal gusts. The effects of each of the stability derivatives on the difficulty of the control tasks and on the closed-loop gust responses are determined. It is clearly shown that the handling qualities studies of control sensitivity and angular damping must consider the influences of M_u (or L_v) and should include gust inputs. These conclusions are substantiated by previous variable-stability-helicopter experiments. The effects of vehicle size and geometry are investigated by several approaches. The key result of increasing size is found to be a reduction in M_u and L_v which can, in turn, lower the requirements for control power and damping. The handling qualities during transition of two vehicles, a tilt duct and a tilt wing, which were previously tested on a simulator are analyzed. It is shown that both trim control and perturbations about the trim conditions must be considered. In fact, part of the increased difficulty in landing transitions, in comparison with takeoff transitions, is due to more difficult trim control; the much more stringent position control requirements in landing are also a contributing factor. Author (TAB)

N66-16749# LTV Aerospace Corp., Dallas, Tex. LTV Vought Aeronautics Div.
METHOD FOR ESTIMATING THE CATAPULT PERFORMANCE OF A CARRIER-BASED AIRPLANE Final Report
William W. Kitts and Curtis B. Lucas 17 May 1963 45 p refs (Contract NOw-62-0197-t)
(Rept.-2-53470/3R459; AD-624930) CFSTI: HC $2.00/MF $0.50

A simplified method for predicting the catapult performance of a carrier-based airplane has been developed. The method consists of two parts; (1) the determination of airplane position at the end of the catapult power stroke, and (2) the determination of the motion of the airplane subsequent to leaving the catapult. The method is oriented toward use of a small digital computer; however, the calculations could be performed with only the use of a desk calculator. Author

N66-17028# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
PERFORMANCE, OPERATION AND USE OF LOW ASPECT RATIO JET FLAPPED WINGS
G. K. Korbacher May 1964 44 p refs
(Grant DA-AMC-44-177-63-G9)
(UTIAS-97; AD-448044)

The characteristics of a jet flapped wing of aspect ratio 6 are presented, discussed and evaluated for STOL application. Again, as for high aspect ratio (AR=20) jet flapped wings, a range for most economical jet flap operation is well defined. The angle of attack as an efficient means of lift production loses its usefulness with low aspect ratio jet flapped wings, whereas the optimum jet deflection angle seems hardly affected ($\theta \simeq 55°$). A most efficient jet flap application for STOL calls for a complete integration of the lifting and propulsive systems. In the range of most economical jet flap operation, semi-empirical relationships predict parameter changes accurately enough for practical purposes. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N66-16232# Gulton Industries, Inc., Metuchen, N. J. Alkaline Battery Div.
DESIGN, FABRICATION AND TESTING OF VENTED, RECHARGEABLE SILVER-CADMIUM CELLS Semiannual Progress Report, 6 Dec. 1964–6 Jun. 1965
John A. Harmyk and John H. Brent, Jr. [1965] 77 p
(Contract DA-36-039-ANC-03359(E))
(Rept.-4; AD-624407) CFSTI: HC $3.00/MF $0.75

The items investigated were positive plate capacity at various silver loading levels, negative plate capacity, and dimensional stability of various separator materials under load and under no-load conditions. Based on the results of these tests, prototype cells were built and tested. These cells met the capacity requirements. A restraining load in excess of the specified limit of 20 psi and in the order of 50 to 60 psi was required to meet dimensional requirements. Tests were also run on prototype cells to determine their cycling characteristics, charge retention at 77° and 160° F, overcharge capability, and low temperature capacity. Further work is required in the area of charge retention. The investigation was also concerned with testing of prototype cells, as well as with fabrication of separators and plates for cell assembly. Author (TAB)

02

N66-16267 Joint Publications Research Service, Washington, D. C.
THE EFFECT OF IMPURITIES ON SILICON PHOTOCELLS
M. S. Saidov, A. Arifov, M. R. Akhmedzhanov, and I. Sultanov *In its* Heliotechnol. 3 Jan. 1966 p 1–4 refs (See N66-16266 07-34) CFSTI: $3.00

03

The aim of this investigation was to study the electric and photoelectric characteristics of silicon photocells with various impurities. The photocells used in the experiments were made of p-type silicon with a specific resistance of 0.6 ohm-cm, nonequilibrium current carrier lifetime of $2 \cdot 10^{-6}$ sec, and dislocation line density of $\sim 10^4$ cm^{-2}. Plates $10 \times 10 \times 0.5$ mm in size were cut out of the silicon and then given appropriate physical and chemical treatment. Copper, nickel, and iron impurities were introduced into the silicon by deposition with subsequent annealing; the other impurities, from the gaseous phase by diffusion annealing (homogenizing). P-n junctions were created by diffusion of phosphorus at 1150°C for 15 minutes, also in ampoules similarly sealed. The ohmic contacts were made by electrolytic deposition of palladium and nickel. The lifetimes of nonequilibrium current (τ) carriers in the photocell base measured by the phase method are given. It is evident that 9-hour annealing of the silicon at 1150°C reduces τ by more than two orders. The same thermal treatment in the presence of zinc, aluminum, copper, iron, indium, manganese, sodium, potassium, or mercury decreased the τ of silicon by one order. Author

N66-16269 Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL STUDY OF EFFECT OF INACCURATE ORIENTATION OF SOLAR MIRROR DEVICE ON ITS POWER CHARACTERISTICS
R. A. Zakhidov and D. I. Teplyakov *In its* Heliotechnol. 3 Jan. 1966 p 11–18 refs (See N66-16266 07-34) CFSTI: $3.00

This article presents the results of an experimental study of the effect of inaccurate solar orientation of the paraboloid-mirror solar devices on effective concentrating capacity under static conditions. The effect is experimentally evaluated from the apparent displacement of the sun in the sky when the device is stationary. Radiation flux densities near the geometric focus of the mirror are determined by calorimetric methods. Author

N66-16271 Joint Publications Research Service, Washington, D. C.
BAND FACET COLLECTORS
A. Sh. Sharafi and G. A. Kleyn *In its* Heliotechnol. 3 Jan. 1966 p 24–26 refs (See N66-16266 07-34) CFSTI: $3.00

A brief discussion is given of metallic facetted solar collectors used for increasing the concentration of solar radiation by a factor of four to six. These are made of electropolished aluminum or metallized film, and are shown to be good reflectors of the ultraviolet section of the radiation spectrum. Consideration is given to the calculation of the facet width and the amount of facet increase from the center to the edges. C.T.C.

N66-16278 Joint Publications Research Service, Washington, D. C.
ON COMPUTING THE OPTIMUM EFFICIENCY OF SOLAR THERMOELECTRIC GENERATOR
B. Arazmedov *In its* Heliotechnol. 3 Jan. 1966 p 51–53 refs (See N66-16266 07-34) CFSTI: $3.00

Expressions are presented for calculating the optimum efficiency of a solar thermoelectric generator. Relative to this, calculations are given for comparing this efficiency to the hot-junction temperature for regimes both of maximum power and maximum efficiency of the thermobattery itself. M.R.W.

N66-16286# Harry Diamond Labs., Washington, D. C.
PROCEEDINGS OF THE FLUID AMPLIFICATION SYMPOSIUM, VOLUME II
[1965] 395 p refs Symp. held 26–28 Oct. 1965
(AD-623456) CFSTI: HC $7.00/MF $1.75

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12. EXPERIMENTAL PROFILES OF VELOCITY COMPONENTS AND RADIAL PRESSURE DISTRIBUTION IN A VORTEX CONTAINED IN A SHORT CYLINDRICAL CHAMBER J. M. Savino and E. G. Keshock (NASA. Lewis Res. Center) p 269–299 refs (See N66-16298 07-12)

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16. TURBULENCE AMPLIFIER FOR INTEGRATED TWO-DIMENSIONAL FABRICATION E. E. Metzger and C. G. Lomas (Bowles Eng. Corp.) p 363–384 (See N66-16302 07-03)

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N66-16287 Harry Diamond Labs., Washington, D. C.
A TEMPERATURE-INSENSITIVE PNEUMATIC OSCILLATOR AND A PRESSURE-CONTROLLED PNEUMATIC OSCILLATOR
J. M. Kirshner and C. J. Campagnuolo *In its* Proc. of the Fluid Amplification Symp., Vol. II [1965] p 5–19 (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

Theoretical and experimental results are presented for a pneumatic oscillator which is relatively insensitive to temperature and, under certain circumstances, may be forced to oscillate at a temperature approximately proportional to pressure. Even though a binary amplifier was used to obtain the gain needed to make up for the attenuation in the feedback line, the output was almost sinusoidal because of the filtering action of the feedback line. A flatter experimental curve in the vicinity of its maximum is obtained for the oscillator than would be predicted by theory, and this is probably due to the fact that temperature and pressure in the feedback line are functions of position. For the frequency/pressure dependent oscillator, the discrepancy between theoretical and experimental frequency curves is not as great. When a relaxation oscillator was tested with lumped circuits, it was found that feedback resistance could be adjusted to obtain a frequency peak in the same temperature region. The curve, however, was not as flat as when a duct is used in a distributed RC feedback oscillator. M.W.R.

N66-16288 Bowles Engineering Corp., Silver Spring, Md.
DEVELOPMENT OF A PRESSURE CONTROLLED OSCILLATOR FOR FM SYSTEMS
Francis M. Manion *In* HDL Proc. of the Flud Amplification Symp., Vol. II [1965] p 21–45 (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75
(R-7-11-65)

A newly-designed pressure-controlled oscillator, with a high conversion rate and noise-free signal, is considered an excellent analog-to-digital converter. A feedback circuit, which utilizes differences in jet transport time to change frequency, effects the necessary phase shift in the feedback loop to obtain a linear relationship between signal input pressure and output frequency. Major advantage of this AC device for FM systems is that it can operate at extremely low levels much more efficiently than DC or continuous flow devices. Input pressure range is compatible with the vortex rate sensor. Gain of the oscillator, whose conversion rate is over 800 cycles/sec/psia, is about 30 cycles/sec for each inch of water change of input pressure. Frequency response of the oscillator is at least half of its operating frequency of 100 cps. M.W.R.

N66-16291 Mattell, Inc., Hawthorne, Calif.
EXPERIMENT AND THEORY OF ACOUSTICALLY CONTROLLED FLUID SWITCHES
Happy Hugh Unfried *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 113–127 refs (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

The successful operation of frequency selective acoustically controlled fluid dynamic switches requires three conditions to exist simultaneously: (1) the stream must be in a monostable region of operation, (2) stream operation takes place in the flow region which is most sensitive to small disturbances, and (3) an acoustic resonator is coupled to the orifice to control flow at this point and to increase frequency selectivity. A stream which is stable along one nozzle boundary in the undisturbed state may be switched to a second stable condition along the opposite boundary when flow is disturbed, if only the first two conditions exist. Greater sensitivity and selectivity can be achieved if the third condition is present simultaneously. When the disturbance is removed, the stream returns to its original stable state. Studies were made at Reynolds numbers between 300 and 4000, Strouhal numbers between 0.07 and 0.3, and input signal levels from 0.5 to 50 dynes/cm^2. Response time and sensitivity of the device depend primarily on the proximity of the operating monostable point to the bistable region. M.W.R.

N66-16293 Honeywell, Inc., Minneapolis, Minn. Military Products Group.

EFFECT OF RECEIVER DESIGN ON AMPLIFIER PERFORMANCE AND JET PROFILE OF A PROPORTIONAL FLUID AMPLIFIER

John A. Kallevig *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 163–184 refs (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

Experimental data with a proportional amplifier with a one-half inch power nozzle is presented to show the effects of receiver geometry on the upstream velocity and total pressure profiles and amplifier performance. The work has two major sections. The first part covers the extreme case where the outlets are completely blocked and all of the flow exits through the vents. The second part consists of a survey of the pressure distribution and velocities within the amplifier having no vents, i.e., all of the flow exiting through the receiver. These data were taken using four different receivers and bellmouth configurations. Author

N66-16294 Nebraska Univ., Lincoln.

STEADY AND TRANSIENT BEHAVIOR OF A BISTABLE AMPLIFIER WITH A LATCHING VORTEX

Turgut Sarpkaya *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 185–205 ref Sponsored by HDL (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

Steady and transient behavior of an unvented, cusped, bistable amplifier was investigated by experiments conducted with air and water as the working fluids. The evolution of the latching vortex and the variation of pressure at about 15 critical points in the interaction region were studied for switching (1) by restricting the on-side load port, and (2) by applying a signal to the on-side control port. Each type of switching was investigated under quasi-steady and transient conditions. The pressure perturbations in the interaction region, evolution of pressure in the attachment bubble, formation of vortices at the two sides of the cusp, the differences between the transient and quasi-state switching, and the propagation of shock waves are discussed with the help of normalized curves and motion pictures. Author

N66-16295 Bendix Corp., South Bend, Ind. Bendix Products Aerospace Div.

PERFORMANCE CHARACTERISTICS OF VORTEX AMPLIFIERS

G. R. Howland *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 207–221 (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75
(BPAD-863-16608R)

Recent developments and performance characteristics are reviewed for the vortex amplifier, which is considered to have many advantages over pure fluid devices. These include ease in fabrication by conventional machining techniques and reliable and predictable operation over an almost infinite range of pressure differentials. The vortex valve can be scaled over a wide range of sizes, as dictated by specific needs; and it does not contain any splitters, receivers, or other critical geometric shapes. Push-pull circuits can increase the potential usefulness of the vortex amplifier, and the conservation of flow in multiple staging can provide high efficiency power. Consideration is given to load pressure pickoffs, multiple inputs and bias control, and dynamic response characteristics of the vortex valve as an amplifying device. Both the single ended and push-pull circuits are discussed for amplifier staging. The adaptability of the vortex amplifier is indicated by a description of two different applications for the device, in a compensation network and a commutation circuit. M.W.R.

N66-16296 Case Inst. of Tech., Cleveland, Ohio.

FLUID VORTEX AMPLIFICATION OPTIMIZATION

Isaac Greber, P. E. Koerper, and C. K. Taft *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 223–243 refs (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

A vortex amplifier is designed to obtain maximum flow shutoff capability. Empirical relations are established which describe the maximum flow conditions of the amplifier. They are used to predict the shutoff capability as a function of the amplifier outlet and inlet areas, and consequently to design for maximum shutoff. The optimized amplifier produced a flow shutoff of less taan 9 percent maximum flow and was a bistable, hysteretic device. A non-hysteretic amplifier was designed by modifying the hysteretic amplifier. Its shutoff capability is less than 14 percent of maximum flow. Author

N66-16297 Nebraska Univ., Lincoln.

CHARACTERISTICS OF A VORTEX DEVICE AND THE VORTEX-BREAKDOWN PHENOMENON

Turgut Sarpkaya *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 245–268 refs (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

Forced and periodic breakdown of a confined vortex by another vortex rotating in the opposite direction is investigated. The vortex tube consists of two chambers connected by a short tube through streamlined transitions; plain wall closes the upstream end and a circular orifice is at the downstream end. Swirling-flow and breaker vortex are generated by the introduction of air and water through tangential ports near the ends. The vortex device, because it produces a sharp, strong signal at the time of breakdown, can be applied to switching, binary counting, pressure modulating, and speed governing. Vortex breakdown requires one or more triggers, such as the counter vortex motion and/or the adverse pressure created by the divergence of the connecting tube into the downstream chamber. Coupled with a Helmholtz resonator, the vortex tube works like a hydrodynamic oscillator whose energy is derived from the hydrodynamic instability of the fluid within a reversed-flow region in the downstream chamber. M.W.R.

N66-16302 Bowles Engineering Corp., Silver Spring, Md.

TURBULENCE AMPLIFIER FOR INTEGRATED TWO-DIMENSIONAL FABRICATION

Eric E. Metzger and Charles G. Lomas *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 363–384 (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75
(R-7-10-65)

Flat configurations are shown to be feasible for low power circuitry design in turbulence amplifiers, with space requirements the only limitations on size and power consumption. Evidence indicates that satisfactory configurations can be made at low Reynolds numbers which will decrease size. For *NOR* logic with two input limits, size reduction can be accomplished by low gain digital amplifier operation. Development is described for a two-dimensional turbulence amplifier *"and"* gate in *"optiform"*. Supply pressure for maximum laminar flow was found to be 0.75 inches of water; and the Reynolds number associated with pressure drop through the control nozzle was approximately 900. Data are presented for one *"and"* gate which was operated at a jet Reynolds number of approximately 100. Impedance curves, characteristics curves, and impedance matching curves are plotted for one, two, and three control nozzles; and these operating characteristics are compared with those for a turbulence amplifier without a center dump hole. It is shown that if some degradation in performance can be tolerated, the dump hole need not be cut and a great savings in fabrication time can be effected. M.W.R.

N66-16303 Bowles Engineering Corp., Silver Spring, Md.
DIGITAL DATA HANDLING SPEEDS WITH PURE FLUID (PNEUMATIC) CIRCUITS
Peter Bauer and Eric E. Metzger *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 385–403 (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

Digital data handling speed considerations for pure fluid (pneumatic) circuits are discussed for element and subcircuit capabilities as well as complete systems. Present and future capabilities are investigated, and extreme boundaries are placed on both logic requirements and projected future pure fluid element performance; for example, an ADD time for 15 bit binary numbers of the order of 1.5 milliseconds. Digital data handling is defined as the manipulation of numerical data in the form of discrete level signals; and a discussion of speed capabilities is limited to digital data handling speeds with pure fluid circuits. Propagation delay circuits and elements are investigated; and size, power level, and fluid medium as well as speed criteria and boundaries are discussed. Pure fluid digital systems are considered in terms of applications where speed presents no problem and where high speed operation is required; an automatic digital sequence control system is given as an example of the first category and a pure fluid digital timer system is an application of the latter. M.W.R.

N66-16418# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development.
RF SENSITIVITY OF ELECTROEXPLOSIVE DEVICES USED IN THE AGENA D SPACE FLIGHT VEHICLE. VOLUME 1: LABORATORY TESTS Final Report
Paul F. Mohrbach and Robert F. Wood Apr. 1964 359 p refs Prepared for Lockheed Missiles and Space Co.
(F-B2118-1)

Thirteen types of electroexplosive devices (EEDs) were evaluated for sensitivity using direct current stimuli and radio frequency stimuli. The dc tests consisted of constant current sensitivity, dynamic resistance, thermal time constant, and prepulse studies. There were no unusual characteristics noted during these tests. RF sensitivity, cook-off and dudding tests were conducted over the range of 10 Mc to 9000 Mc with power applied pin-to-pin and pin-to-case both continuous wave and pulsed. The CW pin-to-pin sensitivity of all EEDs tested was found to be less than that for dc over the range of 10 Mc to 9000 Mc. Under pulsed conditions several devices were found more sensitive to RF than dc, which may be attributed to arcing from the bridgewire post to the case or possibly in some cases to thermal stacking. Pin-to-case results varied appreciably between devices; for example, out of 100 M-69's tested only 3 fired, while out of 100 M-79's, 43 fired. The DT-154 is sensitive to pulsed RF in the pin-to-case mode because of overhanging bridgewires that promotes arcing. A pin-to-case test in which one lead was left open showed that the bridgewire could be made to glow, even though the energy was not applied directly to the bridgewire. Author

N66-16419# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development.
RF SENSITIVITY OF ELECTROEXPLOSIVE DEVICES USED IN THE AGENA D SPACE FLIGHT VEHICLE. VOLUME 2: DATA SHEETS Final Report
Paul F. Mohrbach and Robert F. Wood Apr. 1964 168 p Prepared for Lockheed Missiles and Space Co.
(F-B2118-2)

The Bruceton data sheets, pin to case tests, and radio frequency dudding tests are presented. This mass of information includes figure and table numbers to enable one to follow the text material which is printed in a separate volume of this report. R.R.D.

N66-16447*# Radio Corp. of America, Lancaster, Pa. Electron Tube Div.
THE DEVELOPMENT OF A CESIUM-VAPOR-FILLED THERMIONIC ENERGY CONVERTER Final Technical Report
G. Y. Eastman and D. M. Ernst Dec. 1962 182 p Prepared for JPL
(Contracts NAS7-100; JPL-950229)
(NASA-CR-69861) CFSTI: HC $4.00/MF $1.25 CSCL 10A

This report covers development, fabrication and test of cesium-vapor-filled thermionic energy converters. The units were designed for use in a solar-heated space application. The geometry was limited by stringent system parameters of size and temperature. The program was directed toward the generation of twenty-five watts of output power at an emitter temperature not exceeding 2000° K. Design objectives included a service life of one year at rated capacity at an efficiency of twenty percent. RCA has delivered five converters designed to these requirements at operating temperature of less than 2000°K. The objectives of life and efficiency have been approached by incorporating materials and fabrication techniques which will obtain the greatest reliability and performance. The report covers the specific techniques, procedures and geometry of the converters shipped under the contract. In addition, details of problems encountered and their solutions are explained. Test data on converters shipped is included. Author

N66-16465*# Goodyear Aerospace Corp., Akron, Ohio.
CONE AND COLUMN SOLAR CONCENTRATOR MODEL Final Report
Thomas J. Mc Cusker Jul. 1965 110 p refs
(Contract NAS1-4341)
(NASA-CR-66012; GER-12268) CFSTI: HC $4.00/MF $0.75 CSCL 10B

This report summarizes the design feasibility analysis, the cone development program, and the preprototype optical model construction which comprise the present cone and column

solar concentrator development program. The design feasibility analysis is based on a 60 foot diameter concentrator with the capabilitity of focusing 95 percent of the focal plane energy within a 1.9 foot diameter circle. An optical analysis is made to translate the performance requirements into structural sizes and tolerances. Based on these structural requirements, a packaging/erection scheme is detailed which can be analyzed structurally and thermally. The cone development program shows that simply constructed membrane cones do not meet the optical requirements of the cone and column concentrator. A suitable cone was developed which consists of conical sectors with film stiffeners attached to the outside surface. A 5 foot diameter preprototype optical model was constructed. This model employs the cone construction developed as part of this program. Author

N66-16520# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.

RESEARCH AND DEVELOPMENT OF FLUID AMPLIFIERS FOR TURBOPROPULSION SYSTEM CONTROL Final Report

Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 30 Jun. 1964 277 p refs

(Contract AF 33(657)-8384)

(APL-TDR-64-82; DSR-9159-2; AD-624091) CFSTI: HC $6.00/MF $1.50

Techniques for sensing the relative threat of flow instabilities in jet engines have been a long sought-after goal. This is the final report of a study aimed at determining the feasibility of certain types of fluid jet amplifiers used as fast pressure and temperature sensors. The more theoretical aspects of the report include a study of the statics and dynamics of the interaction of a fluid jet and a receiver port, the dynamics of the controlled deflections of jets in fluid amplifiers, and the dynamic analysis of fluid systems. The more applied aspects include the design of a fluid-relay stall-cell sensor, a fluid diode possibly useful for sensing blade wakes or stall cells, and a unique reference-frequency penumatic oscillator. Author (TAB)

N66-16560*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A PHOTOVOLTAIC SOLAR SENSOR FOR USE IN SPACECRAFT ORIENTATION CONTROL SYSTEMS

Anthony Fontana (M.S. Thesis—Virginia Univ., Oct. 1965) Washington, NASA, Feb. 1966 36 p refs

(NASA-TN-D-3279) CFSTI: HC $2.00/MF $0.50 CSCL 10A

A simple photovoltaic solar sensor has been designed, constructed, extensively ground tested in simulated space environments, and space tested during a suborbital flight. The sensor has the capability of solar capture from any initial orientation within its spherical field of view and the capability of accurate pointing toward the solar target without the introduction of error by earth-reflected solar radiation. The sensor has a repeatability of ±2.4 seconds of arc at a pointing error of 1 minute of arc. The sensitivity and linear range of the sensor are adjustable. State-of-the-art protection from space radiation degradation is provided. The sensor is conservatively estimated to have an earth-orbit lifetime of 10 years with no more than 10-percent degradation. Author

N66-16611# Frankford Arsenal, Philadelphia, Pa. Propellant Actuated Devices Div.

DESIGN IMPROVEMENT OF HIGH TEMPERATURE INITIATOR DESIGNATED "INITIATOR, CARTRIDGE ACTUATED: XM100"

George P. Miller Nov. 1965 33 p

(R-1760; AD-625572) CFSTI: HC $2.00/MF $0.50

In this project a program was originated to improve an M27 type of initiator. The improved model was designated XM100. Essentially, there were eight major and sixteen minor modifications, all intended to reduce costs, increase efficiency, and promote safety. Once the unit has been fired, important safety features are: it cannot be mistaken for an unfired unit; it cannot be installed as an operational unit; nor can it be reassembled inadvertently. a universal mount enables the unit to be located in any of the normal positions, including bulkhead mounting. A new, hermetically sealed cartridge and the high energy 120-inch ounce firing mechanism increase reliability. The over-all design shows that this initiator embodies most of the improvements suggested by user and as projected by experienced design engineers. Author (TAB)

N66-16685# General Motors Corp., Kokomo, Ind. Delco Radio Div.

STUDY OF GERMANIUM DEVICES FOR USE IN A THERMOPHOTOVOLTAIC CONVERTER First Quarterly Report, 1 Jul.–1 Oct. 1965

D. P. Crouch and R. W. Beck Jan. 1966 129 p refs

(Contract DA-28-043-AMC-01420(E))

(ECOM-01420-1; AD-624868) CFSTI: HC $4.00/MF $1.00

Experimental cells containing various structural design variations were fabricated and tested. The effects of grid configuration variations and grid material variations on device performance were investigated. An examination of the effect of acceptor concentration variations in the P+ layer of the N on P+ device was made. A study of the optical generation resistivity compromise between decreased resistivity for increased open circuit voltages and curve factors and increased resistivity for increased short circuit currents was initiated. Optical and electrical evaluation was performed on the first group of vendor processed anti-reflection coated devices. The initial experiments involving the determination of the effects of various front surface chemical treatments on the performance and stability of the absorptive device were made. Passivation studies were started to determine the effect of thin front surface diffused layers on the performance and stability of the N on P+ absorptive device. A system for epitaxial deposition of germanium utilizing the iodine disproportionation in a close-space transport configuration has been constructed. Author (TAB)

N66-16693*# Electro-Optical Systems, Inc., Pasadena, Calif.

ANALYSIS OF POTENTIAL SECONDARY EXPERIMENTS FOR A SOLAR-THERMIONIC FLIGHT TEST VEHICLE. VOLUME III: ENGINEERING EXPERIMENTS CATALOG Final Report, 14 May–15 Oct. 1965

19 Nov. 1965 151 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951162)

(NASA-CR-70048; EOS-6961, Vol. III) CFSTI: HC $4.00/MF $0.75 CSCL 10A

A description of representative engineering experiments which are applicable to a solar-thermionic flight test vehicle is presented. The experiments are mainly concentrated in the power technology area because of the accurate sun orientation of the spacecraft, presence of the solar thermionic experiments, and the ability of the spacecraft to accommodate a large number of solar-orientated experiments. Thermal control, mechanical, attitude control, telecommunications, optical, and supporting science experiments are also summarized. M.R.W.

N66-16736# Naval Ordnance Lab., Corona, Calif.
CHEMOELECTRIC ENERGY CONVERSION FOR NON-AQUEOUS RESERVE BATTERIES Quarterly Report, Jul.–Sep. 1965
1 Nov. 1965 54 p refs
(NAVWEPS-8832; AD-624811) CFSTI: HC $3.00/MF $0.50

Investigation of materials for use as reference electrodes in liquid ammonia solutions was accelerated by using a polarization hysteresis method that allows rapid screening of electrodes. This method was applied to nitrided wires and disks. Models of reference electrodes of the first kind were made for use in pressurized cells. Chronopotentiometric and cyclic voltammetric techniques were applied to potassium amide and other electrolytes to detemine their limiting electrochemical parameters. An investigation of the electrochemical and physical properties of ammonia-like solvent systems was begun to find a solvent with the advantages of ammonia and fewer disadvantages. As a start, the lower aliphatic amines were studied. Methylamine and ethylamine were found to be good solvents for lithium nitrate, but trimethylamine did not dissolve typical ionic compounds to form conducting solutions. The conductivity of the dilute solution increases as the solvent changes from pyridine to ethylamine to methylamine to pyridine-ammonia. Conductivity of moderately concentrated solutions was an order of magnitude less than that of ammonia solutions. Experiments conducted with single cells of 1 sq cm area indicated that solution activation produced better performance than solvent activation, in cells with Mg anodes, but cells incorporating perchlorate electrolytes and an amalgamated Mg anode were erratic and will be redesigned for further study.
Author (TAB)

N66-16921*# Bendix Corp., Southfield, Mich. Research Labs. Div.
ANALYTICAL STUDY OF THE FEASIBILITY OF A PNEUMATIC NEUTRON FLUX DETECTOR
May 1965 113 p refs
(Contract NAS3-6207)
NASA-CR-54468; BRLD-2933) CFSTI: HC $4.00/MF $0.75 CSCL 13G

An analytical study to determine the feasibility of developing a pneumatic neutron flux detector has been conducted. The concept examined consisted of an electrofluidynamic pump for converting thermal neutron flux to a pneumatic pressure signal which is amplified by a logarithmic vortex amplifier. At least five decades of neutron flux from 10^7 to 10^{12} neutrons/cm^2-sec can be detected. Response times approaching 0.06 sec can be achieved. Quantitative definition of accuracy requires additional experimental evaluation. Methods of gamma compensation, sensitivity to temperature changes, and capability of meeting operational modes were also considered in this feasibility analysis. A conceptual design of a feasible neutron flux detector is provided.
Author

N66-16985*# Marine Engineering Lab., Annapolis, Md.
AUTOMATIC BATTERY FORMATION CYCLER AND CONTROLLER
Floyd E. Ford Jul. 1965 23 p ref
(NASA Order S-12730-G)
(NASA-CR-68529; MEL-50/65; AD-467988) CFSTI: HC $1.00/MF $0.50 CSCL 10C

An automatic cycler and controller has been designed to determine charge capacity and perform appropriate charge/discharge operations on electrochemical cells intended for use as satellite power sources. This device is capable of monitoring up to 20 series-connected cells at a time and characterizing each cell according to its terminal voltage and ampere-hour capacity.
Author

N66-17013# Gulton Industries, Inc., Metuchen, N. J. Alkaline Battery Div.
DESIGN, FABRICATION AND TESTING OF SEALED, RECHARGEABLE SILVER–CADMIUM CELLS Semiannual Progress Report, 6 Dec. 1964–6 Jun. 1965
G. M. Apgar 19 Mar. 1964 78 p
(Contract DA-36-039-AMC-03358(E))
(Rept.-4; AD-624410) CFSTI: HC $3.00/MF $0.75

The items investigated were positive plate capacity at various silver loading levels, negative plate capacity, and dimensional stability of various separator materials under load and under no-load conditions. Based on the results of these tests, prototype cells were built and tested. These cells met the capacity requirements. A restraining load in excess of the specified limit of 20 psi and in the order of 50 to 60 psi was required to meet dimensional requirements. Tests were also run on prototype cells to determine their cycling characteristics, charge retention at 77°F and 160°F, overcharge capability, and low temperature capacity. Further work is required in the area of charge retention. The investigation was also concerned with testing of prototype cells, as well as with fabrication of separators and plates for cell assembly.
Author (TAB)

N66-17125# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
ELECTRICAL POWER SYSTEMS FOR THE MANNED ORBITING LABORATORY
Michael R. Anderberg (M.S. Thesis) Oct. 1965 184 p refs
(Contract AF 33(608)-1269)
(AD-624668) CFSTI: HC $5.00/MF $1.00

This paper is a detailed design study of possible electrical power systems for the Air Force's manned orbiting laboratory. The mission requirements and details are reviewed to the extent that they are known in the open literature and a set of power requirements is derived. On the basis of reliability, availability, and weight considerations, only solar cells, fuel cells, secondary batteries and combinations thereof are selected for detailed analysis. For the 30 day mission it is concluded that if no experiments are required during the shadow portion of the orbit, the integrated battery/solar cell system is superior by a large margin. If experiments are required in the shadow period, it is found that either the fuel cell system or the battery/solar cell system may be optimum depending on the magnitude and type of power required. It is also found that for a 60 day mission only the battery/solar cell system can be seriously considered. The analysis of the three power systems in support of the design study is developed step by step and may be used as a detailed guide for analyzing the characteristics of these systems for other missions.
Author

N66-17229*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE MEASUREMENT AND APPLICATION OF THE QUANTUM YIELD OF SOLAR CELLS USING A FILTER TECHNIQUE
William G. Gdula (Tsag Designs, Inc.), and Daniel J. Gallagher Sep. 1965 24 p ref
(NASA-TM-X-55372; X-713-65-372) CFSTI: HC $1.00/MF $0.50 CSCL 10A

The measurement of absolute quantum yields of solar cells by means of narrow-band interference filters is described. Optical properties of the filters and representative experimental data obtained were applied to the quantum yield measurements in radiation damage experiments. Unique solar cell fabrication techniques and diffusion length measurement are briefly presented. Author

N66-17236*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL ANNEALING OF RADIATION DAMAGE IN SOLAR CELLS
P. H. Fang Nov. 1965 103 p refs
(NASA-TM-X-55399; X-713-65-468) CFSTI: HC $4.00/MF $0.75 CSCL 10A

Several tests of the isothermal and isochronal methods for the annealing of proton and high energy electron radiation damage in silicon solar cells were successfully carried out. Various types of both N–P and P–N junction solar cells were used. The experimental techniques are described, and the temperature dependence of radiation damage is demonstrated. A system is proposed for annealing damage in a space mission situation. D.T.

N66-17260*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CHARACTERISTICS OF THE SOLAR ARRAYS FOR THE ENERGETIC PARTICLE EXPLORERS
Luther W. Slifer, Jr., Ralph M. Sullivan, and Nicholas V. Mejia, Jr. Oct. 1965 44 p refs
(NASA-TM-X-55377; X-716-65-392) CFSTI: HC $2.00/MF $0.50 CSCL 10A

The electrical and mechanical characteristics of the solar arrays, solar paddles, solar cells and some other solar paddle components have been compiled for the Explorer XII, XIV, XV, and XXVI satellites. The characteristics are presented so as to point up the similarities and differences in the solar arrays and afford a correlation of the design features and the requirements leading to those features. These comparisons also illustrate the development in the state of the art of solar arrays and solar cells for the period from 1960 to 1963. The predicted air mass zero power based on air mass one measurements is presented and compared to telemetered data from the spacecraft. The comparison was within 5% although it was anticipated to be only within 10%. It is shown that the final utilization efficiency of the solar cells was less than 1% and several areas where future efforts should be concentrated are suggested in order to improve this figure. Author

N66-17253*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ATMOSPHERE EXPLORER-B SOLAR ARRAY (AE-B)
Edwin Moses Oct. 1965 21 p
(NASA-TM-X-55380; X-716-65-401) CFSTI: HC $1.00/MF $0.50 CSCL 10A

The mission objective of the Atmosphere Explorer-B solar array to provide power to recharge the spacecraft's silver zinc batteries after a six-month discharge is described. The plan is to alternately switch each of the satellite's eight battery strings to the array output which will replace 70% of the energy lost during discharge. It is indicated that this accomplishment will extend the spacecraft lifetime by at least six months. Problems associated with the array program revolved around illumination testing. First, since the array is bonded directly to the satellite substrate, illumination testing was limited to availability of the spacecraft from the assembly and integration areas. Second, since a given patch is spread over a relatively large area of a curved surface, the normal illumination varies over the patch. Consequently, the patch output is limited because some of the modules within the patch are more inclined from the normal incidence than others, thus given lower output. It is concluded that it is desirable to restrict the size of the patches so that the illumination variance over them is minimized. R.R.D.

N66-17256*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SILVER ZINC BATTERIES POWER SUPPLY FOR THE ATMOSPHERE EXPLORER-B SPACECRAFT (AE-B)
P. C. Donnelly and C. F. Palandati Oct. 1965 28 p refs
(NASA-TM-X-55383; X-716-65-405) CFSTI: HC $2.00/MF $0.50 CSCL 10C

The characteristics and operation of the silver–zinc batteries which comprise the primary power supply for the Atmosphere Explorer-B spacecraft (AE-B) are described, as well as the cell characteristics, design, and charging technique. The power supply is composed of eight batteries or series strings of Yardney modified HR-type silver–zinc cells. It is pointed out that it is essentially the same system used on Explorer XVII, with the following two major exceptions: (1) The AE-B has limited recharge capability through the use of body-mounted solar cells. (2) The power system for the AE-B is redundant, in that the major experiments, command receivers, programmers, and telemetry are redundant and are operated from different batteries. It is indicated that the loss of any one battery cannot result in the loss of the operation of the satellite. The cells for the AE-B, although similar to those used on Explorer XVII, were substantially improved in capacity; and wet stand losses and out-gassing were reduced. A proposed battery capacity table and a servicing and inspection sheet are included. R.R.D.

N66-17258*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY RESULTS OF THE EXPLORER XXVI SOLAR CELL EXPERIMENT
Luther W. Sliffer, Jr. and Stephen G. Mc Carron Oct. 1965 35 p refs
(NASA-TM-X-55385; X-716-65-410) CFSTI: HC $2.00/MF $0.50 CSCL 10A

To determine the integrated radiation effects on solar cells in an intense radiation orbit, an experiment consisting of four, 10-cell, series strings of N/P solar cells was mounted on one of the body facets of the Explorer XXVI spacecraft. Two strings were composed of 1 ohm-cm cells and two of 10 ohm-cm cells. One string of each base resistivity had a 6-mil glass shield and the other of each base resistivity had a 60-mil glass shield. Results show that, in this orbit, the 10 ohm-cm cells with a 6-mil shield provided significantly better radiation resistance than 1 ohm-cm cells with the same glass. When the heavy shield (60-mil glass) is used, the increased resistance is equally significant. The results also show that the use of the higher base resistivity cell provides a significant fraction of the radiation protection afforded by the heavy 60-mil cover glasses but at no cost in weight. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N66-16214# Naval Research Lab., Washington, D. C. Chemistry Div.

THE EFFECT OF LIGHT INTENSITY AND THICKNESS OF CULTURE SOLUTION ON OXYGEN PRODUCTION BY ALGAE Interim Report

R. L. Shuler and W. A. Affens 15 Oct. 1965 24 p refs (NRL-6331; AD-624532) CFSTI: HC $1.00/MF $0.50

Data from a small cylindrical culture unit with variable annular culture chambers indicate that: (a) the rate of oxygen evolution by an algal culture in the linear phase of growth is a logarithmic function of light intensity, and (b) the rate of oxygen evolution per unit volume of suspension is linearly related to the reciprocal of culture thickness. These two relationships have been combined in an empirical equation, which gives the expected variation of the oxygen production rate with light intensity, culture thickness, and suspension volume. The applicability of this equation has been tested on a larger, multi-light culture unit in this laboratory. The agreement between the experimental and calculated oxygen production rates was very satisfactory, suggesting that the equation is not limited to a particular culture unit but may have wide applicability. The efficiency of the culture unit but may have wide applicability. The efficiency of the culture unit from the viewpoint of electrical power utilization has been calculated, and it was found that the maximum conversion of electrical energy to chemical energy based on oxygen evolution was only 0.51 percent. The maximum efficiency in converting light energy to chemical energy was approximately 12 percent. An extrapolation of the experimental results suggests that approximately 2 cubic feet and 30 kilowatts would be required to provide for the oxygen needs of one man. Author (TAB)

N66-16222# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Dept. de la Protection Sanitaire.

EVALUATION AS A FUNCTION OF AGE OF THE EFFECTIVE ENERGY ABSORBED IN ANY GRAM (ε/m) OF ORGANS OTHER THAN THE GASTRO-INTESTINAL TRACT BY THE PRINCIPAL RADIONUCLIDES WHICH COULD EVENTUALLY CONTAMINATE THE FOOD AND THE ENVIRONMENT [EVALUATION EN FONCTION DE L'AGE DES INDIVIDUS DE L'ENERGIE EFFECTIVE DELIVREE A L'UNITE OF MASSE (ε/m) DES ORGANES AUTRES QUE LE TRACTUS GASTRO-INTESTINAL PAR LES PRINCIPAUX RADIONUCLIDES SUSCEPTIBLES DE CONTAMINER LA CHAINE ALIMENTAIRE ET LE MILIEU AMBIANT]

Arlette Garnier Brussels, EURATOM, Oct. 1965 102 p refs in FRENCH; ENGLISH summary

(Contract Euratom-003-61-10PSAF)

(CEA-R-2809; EUR-2425.f) CFSTI: HC $4.00/MF $0.75

In order to evaluate internal radiation doses it is necessary to know the effective energy dissipated in any gram of the organ of reference, which depends, for any radionuclide, on the physical energy (E) absorbed in the body organ, on the relative biological effectiveness (RBE), on the relative damage factor (n) and on the mass of the organ (m). This effective energy may be evaluated as a function of the size and of the mass of the organs, from birth to adult age. This work is done for the principal radionuclides, which could eventually contaminate the food and the environment. Author

N66-16244# Joint Publications Research Service, Washington, D. C.

***VESTNIK* OF THE USSR ACADEMY OF MEDICAL SCIENCES, VOL. XX, NO. 10, 1965**

N. A. Yudayev et al 7 Jan. 1966 158 p refs Transl. into ENGLISH of Vestnik Akad. Med. Nauk SSSR (Moscow), v. 20, no. 10, 1965 p 3-85

(JPRS-33643; TT-66-30087)

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N66-16258# Joint Publications Research Service, Washington, D. C.

SELF-REGULATION AND MEMORY IN THE BRAIN

K. Ivanov-Muroms'kiy et al 26 Jan. 1966 19 p Transl. into ENGLISH from Nauka i Suspil'stvo (Kiev), no. 12, 1965 p 18-25

(JPRS-33898; TT-66-30341) CFSTI: $1.00

The study of neurocybernetics as a functional unity of the cerebral cortical-subcortical processes is briefly outlined. Cortex and subcortex act in concert not only by means of neural stimulation impulses but also by so-called nonimpulse transmissions which vary and retune the excitability of the nerves. Electric cortex stimulation of the temporal sections of the brain produced memories in the form of visual images and sensible speech. As soon as the current was shut off the memories disappeared but if stimulation was renewed at the very same point the same or similar memories were repeated. It was concluded that perhaps the relative role of the temporal regions in memory mechanisms is "higher" than that of other regions of the brain. G.G.

N66-16275 Joint Publications Research Service, Washington, D. C.

THE EFFECT OF CONCENTRATED WHITE AND MONOCHROMATIC RED, GREEN, AND BLUE SOLAR LIGHT ON PLANT GROWTH, DEVELOPMENT, AND YIELD

S. A. Stanko *In its* Heliotechnol. 3 Jan. 1966 p 37-43 refs (See N66-16266 07-34) CFSTI: $3.00

Investigations were made of the effect of concentrated sunlight on seeds and plants. Various experiments were carried out on such crops as grains, oil bearing plants, legumes, and fruits. These were conducted with and without the infrared portion of the spectrum, and for varying time periods. Conclusions are given and it is generalized that the irradiation of the seeds improves the quality, increases yield, and accelerates ripening of the plants. C.T.C.

N66-16308# Philco Corp., Willow Grove, Pa. Bio-Cybernetics Lab.

MYOPOTENTIAL RESPONSE AND THE FORCE OF MUSCLE CONTRACTION Final Report

F. Ray Finley and R. W. Wirta 1 Nov. 1965 118 p refs (Contract Nonr-4292(00))

(Rept.-2386; AD-623951) CFSTI: HC $4.00/MF $0.75

The report correlates myopotential response to varying degrees of muscular exertion and describes the incidence and extent of variability. The scope of the study included the effect of five different loads on six muscle sites in both elbow and shoulder flexion. The data were rendered into tables and into position-torque charts called isomyols. Author (TAB)

N66-16315# Joint Publications Research Service, Washington, D. C.

A MATHEMATICAL DESCRIPTION OF THE PROCESS OF CONTINUOUS CULTURING OF MICROALGAE

I. I. Gitel'zon, B. G. Kovrov, and N. A. Terskov 21 Jan. 1966 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 165, no. 3, 1965 p 692–695

(JPRS-33831; TT-66-30274) CFSTI: $1.00

A mathematical description of the process of culturing microorganisms is presented. Previous research approaches to a description of the process was by a mathematical characterization of the variation of the rate of growth and reproduction of cells with the external and internal parameters. Together with this, another approach to the description of the process of continuous culturing is possible in which the object of analysis is the cell population considered as a whole. Such a "population" approach not only facilitates description of continuous culturing but also permits making known a number of new aspects, the subtle qualities of which cannot be comprehended by a "cellular" description of the process. In this report an attempt has been undertaken to show this on the example of a continuous densistatic culture of microalgae. M.R.W.

N66-16324# Joint Publications Research Service, Washington, D. C.

PROBLEMS OF SPACE IMMUNOLOGY

R. Petrov 27 Jan. 1966 9 p Transl. into ENGLISH from Med. Gazetta (Moscow), 19 Nov. 1965 p 3

(JPRS-33922; TT-66-30365) CFSTI: $1.00

A discussion on the immunologic problems of space biology and medicine is presented. Prerequisites for the study of cosmic immunology are examined: probable pathogenic agents; effect of prolonged flight on resistance to infectious agents; and interaction of organisms with unusual antigens. M.R.W.

N66-16325# Joint Publications Research Service, Washington, D. C.

PHYSIOLOGY OF ADAPTATION TO HIGH ELEVATIONS

M. M. Mirrakhimov 25 Jan. 1966 20 p Transl. into ENGLISH from Sov. Zdravookhr. Kirgizii (Frunze), no. 5, Sep./Oct. 1965 p 3–11 Presented at the Symp. on "Physiol. Adaptations to Heat, Cold, High Elevations, and Deserts" of the 10th Congr. of the All-Union Physiol. Soc.

(JPRS-33871; TT-66-30314) CFSTI: $1.00

Physiological characteristics of high elevation inhabitants were studied to investigate the problems of chronic adaptation of man to high elevations. An attempt is made to clarify the state of physiological functions of individuals with prolonged residence at high elevations, such as aborigines, and in persons with different periods of acclimation (months, years). Physiological functions studied were blood circulation, respiration, enzyme activity, basic metabolism, and blood content. The study shows that in persons residing at high elevations some functions reaca a level characteristic of aborgenes in 6–12 months, while in otherr a period of over 3–5 years is required. The author is convinced that complete acclimatization to high elevations is accompanied by establishment of physiological functions at a qualitatively and quantitatively new level. M.R.W.

N66-16362 Saha Inst. of Nuclear Physics, Calcutta (India).

STUDY ON BONES. I: ORIENTATION AND NATURE OF CRYSTALLITES IN NORMAL BONE. II: STUDY OF COLLAGEN IN DISEASED BONE (UNUSUAL DYSPLASIA)

N. N. Saha, S. Das, A. K. Saha, S. P. Ghosal, and J. Nag Chowdhury (Inst. of Child Health, Calcutta) *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 251–270 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Inorganic crystallites and their structural relationship with the collagen matrix in both normal and diseased human bones were studied by X-ray diffraction, polarization microscopy, chemical analyses, and electron microscopy. Bones were decalcified and their collagen was removed by extraction. Wide angle X-ray diffraction photographs of transverse and longitudinal sections of normal and diseased tibiae were taken with the X-ray beam both perpendicular and parallel to the surface of the sections. It was found that the hydroxyapatite crystallites in normal bone were oriented around the collagen fibrils with their c-axes making an angle of about 41° with the collagen fiber axis. The direction of the normal to the plane $(10\bar{1}1)$ was the fiber axis. In the diseased bones investigated, both the organic and inorganic constituents were disorganized, the inorganic constituent having a very small particle size of random orientation. Proponderance of the long side chain amino acids affected the collagen matrix and led to a predominance of abnormal collagen. These abnormal collagen chains were the sites for abnormal calcifications. G.G.

N66-16363 Bose Research Inst., Calcutta (India).

PHYSICO-CHEMICAL PROPERTIES OF ALPHA-LACTALBUMIN OF GOAT'S MILK

Shila Chaudhuri and A. Sen *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 271–279 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Alpha-lactalbumin was crystallized from goat's milk and analyzed by electrophoresis in the pH range 4 to 6 at 1°C, and by free diffusion in pH 5.4 at 20°C. Sedimentation patterns and solubility tests were also studied. The main physicochemical properties of this protein as observed by tests on: partial specific volume, sedimentation coefficient, diffusion coefficient, molecular weight, frictional ratio, extinction coefficient, and nitrogen content, were found to be closely related to protein constituents of cow's and buffalo's milk. G.G.

N66-16397# Joint Publications Research Service, Washington, D. C.
STUDIES IN BIOLOGY AND INFORMATION
K. S. Trincher 21 Jan. 1966 29 p Transl. into ENGLISH of ch. 3, 9, 11, and concluding remarks from the book "Biologiya i Informatsia, Elementy Biologicheskoy Termodinamiki" Moscow, "Nauka", 1965 p 43–49, 81–89, 95–99, 100–101
(JPRS-33830; TT-66-30273) CFSTI: $1.00

The physical parameters of energy, time, heat flow, interface, and temperature were evaluated for their logical and operational relationships in living systems. The parameter "time" was found to exist only in the microcosm of moving molecules and was not included in the physical state of a macrosystem. Studies on geometric and dielectric structures of a non-nucleated mammalian erythrocyte established a regular network of water ordered in loops and containing spherical dipole molecules of hemoglobin. It was shown that the simultaneous crystal and liquid structure of intracellular water was conjugated with the continuous metabolic functions of the living cell. G.G.

N66-16428* National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
STATUS OF KNOWLEDGE OF WEIGHTLESSNESS 1965
Lawrence E. Lamb *In its* Space Res.: Direc. for the Future, Pt. 3 Feb. 1966 p 191–208 refs (See N66-16426 07-30) CFSTI: HC $6.00/MF $1.75

Available information indicates that the initial physiological changes during manned space flight are related to dehydration. From knowledge of recumbency diuresis and decreases in the hydration level with recumbency, it may be presumed that weightlessness is a contributory factor in dehydration. The occurrence of dehydration in recumbency, and presumably during manned space flight, is an acute self-limiting process that is rapidly reversible when normal ambulatory earth activities are resumed. It can be sharply reversed by short-term application of lower-body negative pressure. Immediate postflight events permit the use of a number of physiological maneuvers that provide protection against decreased orthostatic tolerance and that, in this sense, the operational environment is not analogous to the responses noted from tilt-table or simple standing studies. These maneuvers may offer major protection against post-flight decreased orthostatic tolerance. The g suit or other pressure clothing can be used to provide significant protection against decreased orthostatic tolerance. Preliminary evidence suggests that the acute improvement in hydration brought on by short-term application of lower-body negative pressure abolishes the problem of decreased orthostatic tolerance after bed rest. E.E.B.

N66-16439# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
STUDY OF THE CONSERVATION AND STABILITY OF LABELED MACROMOLECULES [ETUDE DE LA CONSERVATION ET DE LA STABILITE DES MACROMOLECULES MARQUEES]
W. Baeyens, P. Charles, C. Davila, R. Huart, L. Ledoux et al Brussels, EURATOM, 1965 30 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-024-62-3-RISB)
(EUR-2419.f) CFSTI: HC $2.00/MF $0.50

The results, which were presented at the Euratom conference on methods of preparing and storing labelled molecules, relate to: (1) The preparation, properties and storage of nucleic acids labelled by biological synthesis or by tritiation *in vitro*. (2) The study of the properties and storage of ribonuclease and lysozyme at high specific activity. Author

N66-16446*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aerospace Medical Inst.
PRACTICAL AND THEORETICAL IMPLICATIONS BASED ON LONG-TERM FOLLOW-UP OF MENIERE'S PATIENTS TREATED WITH STREPTOMYCIN SULFATE
Ashton Graybiel, Harold F. Schuknecht, Alfred R. Fregly, Earl F. Miller, II, and Michael E. Mc Leod 25 Oct. 1965 29 p refs Joint Report with NASA
(NASA Order R-93)
(NASA-CR-69862; NAMI-948) CFSTI: HC $2.00/MF $0.50
CSCL 06E

Four patients who had received streptomycin sulfate in the treatment of Ménière's disease were evaluated in terms of the long-range effects of therapy and utilized as experimental subjects. The findings are reported in terms of a lack of return of their symptoms, and the effect of the drug on hearing, the semicircular canals, otolith organs, ataxia, and the Coriolis oculogyral illusion. An attempt was made to interpret the findings in terms of the etiology of idiopathic Ménière's disease, and the suggestion is made that it might represent a disturbance attributable to the secretary cells of the crista. Author

N66-16469# Siena Univ. (Italy). Istituto di Patologia Medica.
BRAIN STEM SYSTEMS AND BEHAVIOR Final Scientific Report
Cesare Bartorelli and Alberto Zanchetti 31 May 1965 59 p refs
(Grant AF-EOAR-64-41)
(AFOSR-65-1579; AD-623798) CFSTI: HC $3.00/MF $0.75

The objectives of the research were to compare reflex regulation of waking and emotional behaviors; to identify the pontine centers of deep sleep and their pathways; and to study reflex regulation of circulation during sleep. Author (TAB)

N66-16499# Joint Publications Research Service, Washington, D. C.
STUDIES ON ALGAE IN HUNGARY
Tibor Hortobagyi 4 Feb. 1966 12 p Transl. into ENGLISH from Magyar Tudomany (Budapest), v. 10, no. 11, Nov. 1965 p 718–723
(JPRS-34012; TT-66-30454) CFSTI: $1.00

Various experiments on growing algae, undertaken by several research institutes in Hungary, are reviewed, and the relative merits of each method are compared. The conditions related to the profitable establishment of algae-producing installations are listed. The ability of algae to assimilate and incorporate radioactive elements rapidly and in large amounts is emphasized, and its importance as a potential food material is discussed. The relationship of algae production to the nutritional basis of space research is examined, and it is pointed out that, of all the green microscopic plants, algae correspond best to the requirements. The effect of such experimental findings on agricultural development, and their impact on national economic planning are also assessed. M.G.J.

N66-16506# Kansas State Univ., Manhattan. Dept. of Psychology.
THE EVALUATION OF PERCEPTUAL FRAMES OF REFERENCE Technical Reports 33 Through 36
William Bevan and Harry Helson Nov. 1965 132 p refs
(Contract Nonr-3634(01))
(AD-623869) CFSTI: HC $4.00/MF $1.00

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4. CHANGES IN RESPONSE LATENCY FOLLOWING SHIFTS IN THE PITCH OF A SIGNAL W. Bevan, R. A. Bell, and C. Taylor 17 p refs (See N66-16510 07-05)

N66-16507 Kansas State Univ., Manhattan. Dept. of Psychology.

BEHAVIOR IN UNUSUAL ENVIRONMENTS

William Bevan *In its* Evaluation of Perceptual Frames of Reference Nov. 1965 56 p refs Submitted for Publication (See N66-16506 07-04) CFSTI: HC $4.00/MF $1.00 (TR-33)

The concept of environment, as it has been understood by psychologists during the past half century, is examined, and a substantive review of the pertinent literature during the last decade is provided. Environmental properties that have characterized the psychologist's use of the term in theoretical formulations and investigational practice are considered. Empirical relationships that exist between behavior and unusual environments are also discussed. It is pointed out that while environment as a concept has achieved a degree of formal articulation, it lacks systematic versatility; there are few clearly established bridges between its place in psychological theories and in the empirical practices of the psychological investigator. The value of focussing attention on environment as a variable in observational situations, and as a systematic concept is also pointed out. A comprehensive bibliography is included. M.G.J.

N66-16509 Kansas State Univ., Manhattan. Dept. of Psychology

CONTEXT AND THE PROPERTIES OF BEHAVIOR

William Bevan *In its* Evaluation of Perceptual Frames of Reference Nov. 1965 32 p refs Submitted for Publication (See N66-16506 07-04)
(TR-35) CFSTI: HC $4.00/MF $1.00

In discussing the concept of context and its significance for understanding behavior, two basic points are made: (1) Behavior reflects the principle of relational determination. (2) In identifying the stimulus determinants of behavior, the significant relationships are between response variables and behaviorally effective properties of stimuli. The designs and results of several studies are outlined, and one psychophysical experiment, two in the field of perception, two on reaction time, three on learning, and one on the recall of generic stimuli are reviewed. The conceptual setting for each is given, and the basic notions of adaptation-level theory and the problem of relevance are summarized. It is pointed out that attention to the context problem has effected experimental design in behavioral science by showing the importance of designs, in which the stimulus inputs under consideration are manipulated within subjects or groups rather than between subjects or groups. The conclusion was reached that the methodological approach is the only way by which such phenomena as anchor effects, contrast effects, interpolated stimulus effects, frequency effects, and schedule of reinforcement effects can be studied meaningfully. M.G.J.

N66-16516# Stanford Univ., Calif. Dept. of Genetics

BIOLOGICAL APPLICATIONS OF MASS SPECTROMETRY Final Report, Mar. 1–Jun. 30, 1965

J. Lederberg 1 Aug. 1965 17 p refs
(Grant AF-AFOSR-886-65)
(AFOSR-65-1632; IRL-1030; AD-624074) CFSTI: HC $1.00/MF $0.50

A review is presented of an investigation on the applications of the mass spectrometer to biological research. The mass spectra of the amino acids is examined as well as the spontaneous cyclization of oligopeptides, the optical activity of amino acids, logarithmic recording of the mass spectral data, computer methods and other techniques of analysis, and the heavy particle bombardment of biochemical materials. Included is an article on the optical resolution of D, L amino acids by gas chromatography and mass spectrometry. The use of mass spectrometry is shown for the radio detection of D and L input reagents, as well as to identify the optically active species. Author (TAB)

N66-16536 Army Aviation Human Research Unit, Fort Rucker, Ala.

TRAINING ORIENTED HUMAN FACTORS ENGINEERING OF ARMY AIRCRAFT

Robert H. Wright *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 169–182 ref (See N66-16526 07-04)

The use of a control analog vertically referenced attitude indicator and an integrated VTOL flight display are considered for more economical, efficient training of aviation personnel. It is believed that such a display, in which the indications are directly analogous to the control movements required during flight, will facilitate the acquisition of aircraft control skills in a ground training course device and make the task of flying a helicopter on instruments a fairly easy one. Advantages for low altitude operations include the use of one display focused at a single point, the introduction of very little clutter, and the possibility of integrating the flight display with the navigation display. While the concepts are based primarily on the helicopter VTOL regime, they should adapt well to the requirements of fixed-wing aircraft. M.W.R.

N66-16566*# National Aeronautics and Space Administration, Washington, D. C.

EXTRATERRESTRIAL LIFE—A BIBLIOGRAPHY. PART II: PUBLISHED LITERATURE, 1900–1964

Dec. 1965 345 p refs
(NASA-SP-7015) GPO: HC $2.00; CFSTI: MF $1.75 CSCL 06C

An annotated bibliography of articles and books on extraterrestrial life published during the period 1900 to 1964 is presented. Although the bibliography is primarily concerned with the general subjects of extraterrestrial life and exobiology, its scope also makes provision for several particular topics that are directly pertinent to the search for extraterrestrial life. Included among these are the origin of life on earth, the suitability of other planets for the development of indigenous life, the possibility of intelligent extraterrestrial life forms, techniques and instrumentation for the detection of extraterrestrial life, the chemical basis of life including the synthesis of organic compounds from simple precursors, and terrestrial contamination of spacecraft. Several references which describe the examination and analysis of meteorites and the relevance of such studies to the subject of extraterrestrial life are also presented. C.T.C.

N66-16574*# National Aeronautics and Space Administration, Washington, D. C.

THE OXYGEN DEFICIENCY TEST—PRINCIPLES AND RELATIONSHIPS TO REGULATIVE PROCESSES IN THE ORGANISM [DER SAUERSTOFFMANGELTEST. UBER GRUNDLAGEN UND BEZIEHUNGEN ZU REGULATIVEN VORGANGEN IM ORGANISMUS]

H. Brüner, K. Dietmann, and K. E. Klein Jan. 1966 24 p refs Transl. into ENGLISH from Intern. Z. Angew. Physiol. (W. Berlin), v. 18, no. 1, 1959 p 1–12

(NASA-TT-F-9737) CFSTI: HC $1.00/MF $0.50 CSCL 06P

Systematic investigations of the efficiency deterioration in a defined oxygen deficiency ("altitude position experiment") for a large group of subjects, and mathematical evaluation of the results permit the plotting of a typical, mean deterioration curve and—via a frequency distribution of the end of efficiency—the establishment of two groups, A and B, with different behavior in oxygen deficiency. The "critical threshold" is reached, according to these findings, only after twice the time previously assumed. The mean terminal efficiency and the duration of efficiency have characteristic age curves: both increase up to age 50. Disturbances to autonomic nervous functions behave inversely to the age curves of the mean terminal efficiency. Another striking relationship exists between posthypoxic eosinopenia and the two groups, A and B. The correlations demonstrated indicate further testing of the so-called functional efficiency reserve. Author

N66-16584# Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.

BIOMEDICAL SURVEY OF ATC FACILITIES. I: INCIDENCE OF SELF-REPORTED SYMPTOMS

George T. Hauty, David K. Trites, and William J. Berkley Mar. 1965 54 p refs

(AM-65-5)

From six en route and six terminal air-traffic-control facilities selected on the basis of differences between shift-rotation schedules and high traffic volume, 300 journeymen and assistant controllers were selected as volunteer subjects to complete a biomedical inventory daily for a period of 90 consecutive days. The inventory elicited information relating to health, morale, behavioral habits, and side effects of medications. Of the 300 subjects, 209 fulfilled the reporting requirements of the 90 days. For one of the indexes of information—stress-related symptoms—analyses of the data revealed that: (1) Facilities did differ to a statistically significant degree in the incidence of reported symptoms but these differences could not be attributed to shift-rotation schedules; and (2) 8 hours or less between two successive shifts occasioned the highest incidence of reported symptoms and more than 24 hours between shifts the next highest. Author

N66-16712*# Massachusetts Inst. of Tech., Cambridge.

THE RESISTIVITY OF MICROORGANISMS TO THERMAL INACTIVATION BY DRY HEAT

Gerald J. Silverman 21 Jan. 1966 34 p ref

(Grant NsG-691)

(NASA-CR-70029) CFSTI: HC $2.00/MF $0.50 CSCL 06C

Kinetic studies were conducted on isolates obtained from the soil for determining the resistivity of the microorganisms to thermal inactivation by dry heat. Test spores of *Bacillus subtilis* var *niger* were used in kinetic studies as a standard for comparison. It was found that the population of the test spores, normally a red-pigmented organism, contained a number of mutants, but that their incidence is not very high. The mutants were isolated and their thermal resistivities were compared to that of the culture. Microbial spores, vegetative species, and spores from actinomycetes obtained from a previous thermal-vacuum study are being evaluated. In addition, isolates from desert soils, and air contaminants from missile assembly plants were evaluated. Assay procedures, ovens, and apparatus used are described. Data are tabulated, and plotted. L.S.

N66-16819# Joint Publications Research Service, Washington, D. C.

PROBLEMS OF ELECTRO-AUDITORY PERCEPTION

Chih-an Liang *In its* Transl. on Communist China's Sci. and Technol., No. 275 10 Jan. 1966 p 10–23 Transl. into ENGLISH from K'O Hsueh T'ung Pao (Peking), no. 10, Oct. 1965 p 892–897 (See N66-16817 07-34) CFSTI: $2.00

Present information available on the problems of electro-auditory perception is reviewed and some of its basic principles are outlined. In applying this electrical stimulus, one of the electrodes is placed either in the external auditory canal or within the inner ear, while the other electrode is placed on another part of the body. The sound is actually produced at the interface between the skin and the electrode by the passing of an electric impulse through the human body. Differing frequencies of sound and electrical stimuli evoke in the auditory apparatus the release of nervous impulses of corresponding frequencies so that sounds can be reproduced without relying on the locality mechanism. Experiments proved that a larger area of contact between the stimulating electrode and the skin lining of the external auditory canal gave better audio signals. G.G.

N66-16933# Library of Congress, Washington, D. C. Aerospace Technology Div.

PROBLEMS OF SPACE BIOLOGY (USSR), VOLUME 4, NO. 91, 2 NOVEMBER 1965 Compilation of Abstracts

[1965] 127 p refs A.T.D. Press Spec. Issue

A compilation of abstracts from Soviet literature on problems of space biology are presented. Included are articles on cosmonaut training; space psychology; spaceflight trainers; effect of acclimatization at high altitudes on hypoxia resistance; flight clothing; hygiene; bioprocessing human wastes; cosmonaut immunity and autoflora; isolation and hypokinesia effects; prolonged hypokinesia effect on human resistance to acceleration; physiological effects of partial restraint on monkeys; physiological effects of ammonia, CO, CO_2, and increased O_2; atmosphere selection by animals; helium–oxygen atomospheres; automatic control of plant physiology in closed systems; aeroponic cultivation of cabbage in closed system; higher plants as spaceflight biosensors; *Chlorella* nutrition; ultraviolet irradiation of plants; anti-radiation compounds; radiation effects on animals; biological effects of vibration; noise effect on auditory sensitivity; weightlessness rotation effects on human physiology; human reactions to impacts; methods of measuring blood flow and nerve currents; automatic analysis of EEG's; phonetic speech analysis; information theory and physiological flight data; lip-reading for spacecrew communication; recording tongue movements in speech; and man-machine speech communication. R.N.A.

N66-16955# Cornell Univ., New York. Allergy and Infectious Disease Div.

THE EFFECT OF HYPERBARIC OXYGEN ON MICROORGANISMS IN VITRO AND IN VIVO Final Report

[1965] 17 p

(Contract PHS PM 86-62-170)

Studies to find the effects of hyperbaric oxygen on experimental infections indicated oxygen to effectively kill *C. perfringens* and *C. tetani* in vitro. At 30 psia, however, oxygen has no more bactericidal ability than air at atmospheric pressure. Blood and muscle markedly inhibit the anticlostridial effect on oxygen. Protection by oxygen was observed when mice were infected by injection of *C. perfringens* with infusorial earth into crushed muscle. Oxygen at 30 psia was inhibitory for some aerobic bacterial strains. Mortality rates were not altered, however, by 45 psia oxygen exposure of mice who had been given intravenous injections of the same strains. M.W.R.

N66-16988*# Stanford Univ., Calif. Instrumentation Research Lab.

MEMBRANE SEPARATION

Jerry Lundstrom 6 Oct. 1965 53 p refs

(Grant NsG-81)

(NASA-CR-70190; IRL-1012) CFSTI: HC $3.00/MF $0.50 CSCL 06M

In the study of membrane separation of small enzymatic breakdown products, permeability measurements were made for glucose and carbon dioxide in order to estimate the minimum metabolic rate for conversion of glucose to carbon dioxide. This metabolic rate can then be equated with carbon dioxide production rates from glucose for various microorganisms to gain insight into the sensitivity of membrane separation devices in terms of detectable numbers of microorganisms. Semi-permeable membranes of silicone rubber and teflon were used to simulate microorganic membranes. Results are given in the form of detectability estimates which are applied to life detection problems. The mathematics are given for making these estimates both for a known microorganism and for interpreting experimental results for an unknown organism. Descriptions of experimental equipment, and graphed and tabulated results are given. D.T.

N66-16971*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aerospace Medical Inst.

COMPUTER LIBRARY LITERATURE REVIEW ON EFFECTIVENESS OF ANTIMOTION SICKNESS DRUGS

Charles D. Wood, Robert S. Kennedy, Ashton Graybiel, Robert J. Wherry, Jr., and Richard Trumbull 15 Nov. 1965 21 p refs

(NASA Order R-93)

(NASA-CR-70175; NAMI-949; AD-627012) CFSTI: HC $1.00/MF $0.50 CSCL 06O

A computer library of the antimotion sickness drug literature has been established at the Naval Aerospace Medical Institute. A review of this literature is reported here. The over-all effectiveness of the antihistamines was 70.6 percent; for the belladonnas it was 50.1 percent, and for the phenothiazines it was 44.9 percent. The over-all results of British studies indicated a greater effectiveness for the belladonnas than for the antihistamines, the reverse of U.S. studies. The effectiveness of the individual drugs against motion sickness is also reported. The overall effectiveness of the drugs is compared in sea, air, and experimental-motion studies. Author (TAB)

N66-16991# Naval Submarine Medical Center, Groton, Conn.

SELECTION OF MEN FOR HAZARDOUS DUTY FROM INDICES OF INDIVIDUAL DIFFERENCES IN AUTONOMIC NERVOUS SYSTEM REACTIVITY

Benjamin B. Weybrew 6 Feb. 1965 16 p refs *Its* Mem. Rept.-65-1

(AD-624783) CFSTI: HC $1.00/MF $0.50

The purpose of the report is to integrate the results of a series of studies aimed at assessing the validity of peripheral autonomic indices (respiration rate, tremor, palmar conductance etc.) for predicting individual differences in adjustment to a stressful environment. Based largely upon palmar electrodermal indices, autonomic displacement and recoverability to laboratory induced stress has moderate to high predictive validity with respect to submariner adjustment ratings. Functional autonomic differences may therefore be indicative of underlying emotional traits which in turn are related to differences in adjustment to certain hazardous environments. The data presented in this paper suggest that selected peripheral indices of autonomic function are usefully valid measures of an individual's ability to adapt to the stresses of certain hazard environments. The possibilities of these measures as selection techniques are indicated. Author (TAB)

N66-17005# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

DENATURATION AND RENATURATION OF DNA: I: EQUILIBRIUM STATISTICS OF COPOLYMERIC DNA

Elliott W. Montroll and Narendra S. Goel Nov. 1965 56 p refs

(Contract Nonr-592(22))

(BN-425; AD-624441) CFSTI: HC $3.00/MF $0.50

The one dimensional Ising model, with nearest neighbor correlation only, suitably modified, is used to explain the observed linear dependence of melting temperature of copolymeric DNA with (gc) content. Transition curves are plotted for regular, random, and Markoff distribution of base pairs for various values of a correlation parameter, U, between nearest neighbor bonds. Exact analytic formulae are given for fraction of bonds intact at a particular temperature for various regular distributions for all U and aproximate ones for random and Markoff distributions for small U. A scheme is indicated for further improvement. The model, in principle, makes it possible to estimate the statistical distribution of base pairs from the detailed shape of the transition curve. Author (TAB)

N66-17022# Institute for Perception RVO-TNO, Soesterberg (Netherlands).

CORFICAL CONTROL OF EYE MOVEMENTS AND VISUAL THRESHOLD Final Report, Jun. 1, 1964–Jun. 1, 1965

Maarten A. Bouman [1965] 45 p refs

(Contract DA-91-591-EUC-3346)

(AD-624790) CFSTI: HC $2.00/MF $0.50

Experimental investigations were conducted on the increase in the threshold for visual perception which occurs just prior to, and during eye movements. To measure the visual threshold in the vicinity of eye movement an apparatus was constructed having alternately burning lights. Some time after switching, a flash of short duration of controlled intensity was presented which fell in the vicinity of the subject's eye movement. Eye movements were measured by reflection of light from the surface of the eye. The reflection data is fed to a pattern recognizer which records the onset of eye movement. The subject records whether or not he saw the flash. The threshold for perception as a function of eye movement was measured. The equipment could present one or two light flashes to the subject. Each light source had a dimater of 7 minutes of arc, with an angular separation between the two lights up to several degrees. It was found that the detection of one light flash would facilitate the detection of the other light flash. For example, if the probability of detecting either light, separately, was 0.3, the probability of detecting both together was 0.2, rather than 0.09. This facilitation experiment was then repeated with a resting eye, with the following

results, which hold for both the light adapted and the dark adapted eye: (1) It is most likely a retinal effect, which affects both rods and cones equally. (2) Outside the area of summation the distance between the two flashes is of minor importance. Author (TAB)

N66-17053*# International Business Machines Corp., Rockville, Md. Federal Systems Div.

ORL EXPERIMENT PROGRAM, VOLUME B. PART VII: BIOMEDICINE/BEHAVIOR

21 Feb. 1966 110 p refs

(Contract NASw-1215)

(NASA-CR-70356) CFSTI: HC $4.00/MF $0.75 CSCL 06S

Relative to synthesizing an experiment program for Orbital Research Laboratories (ORLs), an illustration is given of the application of the synthesis approach to the biomedicine/behavior scientific and technical area. The objective of this area is to determine the conditions required to assure man's physiological well being and performance effectiveness for undertaking advanced space missions. Consideration is given to background material which includes discussions of weightlessness, radiation, periodicity, and synergistic effects; identification of selected knowledge requirements; and derivations of experiment requirements. These derivations include equipment functional and supporting research requirements, and prospective orbital activities. Illustrative selected knowledge requirements and discussions of representative experiments are appended. C.T.C.

N66-17058*# International Business Machines Corp., Rockville, Md. Federal Systems Div.

ORL EXPERIMENT PROGRAM, VOLUME B. PART XII: BIOSCIENCE

21 Feb. 1966 123 p refs

(Contract NASw-1215)

(NASA-CR-70342) CFSTI: HC $4.00/MF $1.00 CSCL 06F

Relative to determining a framework for constructing an experiment program for Orbital Research Laboratories (ORLs), an illustration is given of the application of the synthesis approach to the bioscience scientific and technical area. Consideration is given to the identification of selected knowledge requirements and the derivation of experiment requirements. These include equipment functional and supporting research requirements, and prospective orbital activities. Appendices include illustrations and identifications of selected knowledge requirements, relativity experiments using an artificial earth satellite, and indicative phenomena and functional requirements. C.T.C.

N66-17065# Naval Radiological Defense Lab., San Francisco, Calif.

HOMOGRAFT RESPONSE AND HEMAGGLUTININ PRODUCTION BY SENSITIZED THYMECTOMIZED IRRADIATED ADULT MICE

Marvin L. Tyan and Leonard J. Cole 13 Oct. 1965 21 p refs

(USNRDL-TR-920; AD-624485) CFSTI: HC $1.00/MF $0.50

Thymectomized and nonoperated male $B_6D_2F_1$ mice were sensitized by the following means: (1) an allogenic (A/HeJ) skin graft; (2) three sc injections of A/HeJ spleen cells in Freund's complete adjuvant; and (3) three ip injections of A/HeJ spleen cells. One week after the last injection, thymectomized and nonoperated mice from each group received 870 rad whole-body X-radiation. The mice were grafted with A/HeJ and rat skin 102, 143, 184, 205 and 225 days after irradiation. Sera were obtained frequently for anti-A/HeJ and anti-rat hemagglutinins. The results indicated that although both hemagglutinin production and the homograft response were initially greatly impaired by thymectomy and lethal irradiation, repeated antigenic challenge resulted in return of the specific homograft response to near normal reactivity while antibody production became progressively more impaired. The results suggested that (1) antibody production and homograft sensitivity are manifestations of immunologic responses by associated by distinct cell populations, (2) antibody production is more thymus-dependent than is the homograft response and (3) the method of sensitization employed determines both the relative and absolute number of 'sensitized cells' produced within each cell population. Author (TAB)

N66-17072*# Harvard Univ., Boston, Mass. Thorndike Memorial Lab.

A STUDY OF PHYSIOLOGICAL MECHANISMS AND INTER-RELATIONS BETWEEN SYSTEMIC AND REGIONAL BLOOD VOLUME. BLOOD FLOW AND ELECTROLYTE BALANCE Interim Progress Report

Walter H. Abelman and Laurence E. Earley 31 Dec. 1965 10 p refs

(Grant NsG-595)

(NASA-CR-70316) CFSTI: HC $1.00/MF $0.50 CSCL 06P

Results are reported of renal hemodynamics, sodium excretion, and extracellular volume studies conducted with dogs and humans; studies on the effect of mitral stenosis and atrial fibrillation on the excretion of a sodium load in humans, with observations on the effect of cardioversion; and studies on the effect of abnormal circulatory states on the response of heart rate and blood pressure to upright tilt in humans. Relative to these studies, experiments are discussed and conclusions are summarized. C.T.C.

N66-17068*# Army Biological Labs., Fort Detrick, Md. Physical Defense Div.

A STUDY OF DRY HEAT STERILIZATION OF MICROORGANISMS AT 105°C

Dorothy M. Portner 26 Jan. 1966 14 p refs Protect. Branch Rept. of Test No. 6-66

(NASA Order R-35)

(NASA-CR-70321) CFSTI: HC $1.00/MF $0.50 CSCL 06M

Results of an investigation to determine the effectiveness of dry heat at 105°C in sterilizing microorganisms are reported. Thermal death times were determined for (1) natural microbial contamination from aerial fallout or dried bacterial spores on glass surfaces, either embedded or not embedded in plastic; (2) bacterial spores in soil, either embedded or not embedded in plastic; and (3) the natural flora of microorganisms of soil. Among the conclusions are that the time required to achieve sterility varied from 24 to 336 hours. Sterility would be achieved in 24 hours for about 10^6 *B. subtilis* var *niger* dried in glass; but when embedded in plastic, the death time increased to 48 hours. For the glass slides contaminated by aerial fallout, the contamination level was only about 40 microorganisms per slide; but after a 24 hour heat treatment, contamination was found in one sample out of 14 embedded in plastic. Soils artificially contaminated with 10^6 or less *B. subtilis* var *niger* spores appeared to be sterile after 48 hour exposure. C.T.C.

N66-17120# Louisville Univ., Ky. Performance Research Lab.

ELECTRIC SPARK STIMULATION OF THE SKIN

Kent Te Vault (M.A. Thesis) 10 Nov. 1965 31 p refs
(Contract DA-49-193-MD-2525)
(AD-624848) CFSTI: HC $2.00/MF $0.50

On the basis of the data it was concluded that the technique devised by Bishop for exploring the skin's sensory mechanisms is not as simple and as straightforward as it at first appeared. It was, furthermore, not possible to replicate Bishop's findings with regard to simultaneous two-point stimulation. The method of single-unit analysis of the skin is not to be discarded easily, however. Only the method of capacitor-discharge spark stimulation must be drastically revised or abandoned. In order that spark stimulation be effective it is necessary that some means be found to control both the number and spacing of the spikes. This may be achieved by some mechanical or electrical device, but the assumption of a 'single, brief shock' stimulus remains violated. The only remaining desirable change of Bishop's technique, that of avoiding actual contact with the skin, was abandoned by Bishop himself in favor of a thin wire electrode. In light of these facts, it is probably advantageous to look elsewhere for a stimulus source. There are available commercially a number of electronic stimulator devices which are capable of producing single pulses or pulse trains with a considerable degree of control. It is probable that one of these devices, with its output applied to a suitably small area, would provide the needed tool for a truly fruitful exploration of single sensory units of the skin. Author

N66-17126*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE EFFECT OF THE GAS MEDIUM AND PRESSURE ON BODY FUNCTIONS, COLLECTION III
M. P. Brestkin, ed. 1965 311 p refs Transl. into ENGLISH of the book "Funktsii Organizma v Usloviyakh Izmenennoi Gazovoi Sredy, III" Moscow, Izd. "Nauka", 1964 Published for NASA and NSF
(NASA-TT-F-358; TT-65-50136) CFSTI: HC $6.00/MF $1.75
CSCL 06S

Third collection of papers is presented on the effect on the body of increased and reduced total and partial pressures of various gases in ordinary air, as well as artificial air mixtures used in deep-water descents, with special coverage given to the study of caisson disease phenomena. For individual titles see N66-17127–N66-17162.

N66-17127* Israel Program for Scientific Translations, Ltd., Jerusalem.
THE PERMISSIBLE SUPERSATURATION COEFFICIENTS IN HUMAN BEINGS BREATHING AIR AND A HELIUM–OXYGEN MIXTURE [O KOEFFITSIENTAKH DOPUSTIMOGO PERESYSHCHENIYA U LYUDEI PRI DYKHANII VOZDUKHOM I GELIO-KISLORODNOI SMES'YU]
A. I. Aleksandrov and A. P. Brestkin *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 5–9 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

It has been determined that nitrogen forms more stable supersaturated liquid solutions than helium. In this connection it was interesting to determine the permissible supersaturation coefficient (PSC) in human beings breathing air and a helium–oxygen mixture. At the time of our experiments in 1950 there was no experimental data in the literature on PSC values in human beings breathing a helium–oxygen mixture. The values of the PSC used in calculations of deepwater helium–oxygen decompression conditions were determined mathematically by the results of practical descents by divers to great depths, and should therefore be regarded as arbitrarily calculated figures. The values of the PSC were determined in eight professional divers, from 20 to 26 years of age, and in the authors of this work, 28 and 38 years old. The investigation was made in a large pressure chamber. Four subjects participated simultaneously in the same experiment. Author

N66-17128* Israel Program for Scientific Translations, Ltd., Jerusalem.
RELATIONSHIP BETWEEN THE SUPERSATURATION COEFFICIENT OF GAS–LIQUID SYSTEMS AND THE TENSION OF DISSOLVED GAS [ZAVISIMOST' KOEFFITSIENTA PERESYSHCHENIYA SISTEM GAZ–ZHIDKOST' OT NAPRYAZHENIYA RASTVORENNOGO GAZA]
A. P. Brestkin *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 10–17 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

It has been noted that the permissible saturation coefficient (PSC) for divers decreases with increased depth of descent and time spent at the bottom, i.e., with increase in the parameters determining the tension of an indifferent gas in the body tissues. Evidently, such a reduction in the PSC is connected not only with functional changes of the body but also with change of the capacity of the tissues for retaining the dissolved indifferent gas in a state of supersaturation. In this connection, it was very interesting to study the relationship between the tension of the dissolved gas and the supersaturation coefficient (SC) of the solution, the value of which also characterizes the capacity of the fluid for retaining the dissolved gas in a supersaturated state. The study consisted of two series of experiments: in the first a study was made of supersaturated gas–fluid solutions in the pressure range from 1 to 8 atm; in the second, from 10 to 200 atm. The experiments were performed with two fluids (water and benzene) and with three gases (helium, nitrogen, and carbon dioxide). Author

N66-17129* Israel Program for Scientific Translations, Ltd., Jerusalem.
STUDY OF THE SAFE SUPERSATURATION OF THE BODY WITH INDIFFERENT GASES AT DIFFERENT PRESSURES [ISSLEDOVANIE BEZOPASNOGO PERESYSHCHENIYA ORGANIZMA INDIFFERENTNYMI GAZAMI PRI RAZLICHNYKH DAVLENIYAKH]
A. P. Brestkin, P. M. Gramenitskii, and N. Ya. Sidorov *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 18–27 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

In a study of decompression disorders, several circumstances associated with the specific properties of the supersaturated gas–fluid solutions were considered to determine the degree of supersaturation of the animal or human body with indifferent gases at which the first symptoms appear. The concepts of maximum and minimum supersaturation are discussed, and expressions are formulated for the permissible supersaturation coefficient (PSC), the supersaturation coefficient (SC), and the safe supersaturation coefficient (SSC). Details are also given on animal studies to determine the gas formation conditions which lead to functional disorders developing during decompression. Results indicate: (1) It is preferable to determine the limiting supersaturation of body tissues with an indifferent gas by the ratio of the gas tension to the ambient pressure after decompression, than by the difference between these figures. (2) With increase in the tension of the dissolved indifferent gas, the value of the limit increases sharply. (3) With increase in the tension of the dissolved indifferent gas, the value of SSC decreases. M.G.J.

N66-17130* Israel Program for Scientific Translations, Ltd., Jerusalem.

COMPARATIVE DETERMINATIONS OF THE PERMISSIBLE SUPERSATURATION VALUE OF THE HUMAN BODY WITH INDIFFERENT GASES UNDER DIFFERENT CONDITIONS [SRAVNITEL'NOE OPREDELENIE VELICHINY DOPUSTIMOGO PERESYSHCHENIYA ORGANIZMA CHELOVEKA INDIFFERENTNYMI GAZAMI V RAZNYKH USLOVIYAKH]

G. L. Zal'tsman and I. D. Zinov'eva *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 28–33 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

An accelerated method for determining the degree of permissible supersaturation is described. In one test series, comparisons were made of the permissible supersaturation value after the inhalation of air, a 20% helium–oxygen mixture, a 50% air–helium mixture, and a 75% air–helium mixture. The tabulated results show that the maximum pressure, which may be safely reduced to normal after an hour's exposure, depends on the indifferent component of the breathing mixture. It was also noted that the decompression sickness symptoms differed substantially with the various gas mixtures. In other experiments, a comparative determination was made of the permissible supersaturation value in two subjects at three different initial pressures: these were safe surfacing pressure, normal atmospheric pressure with subsequent rarefaction, and the greatest prenarcotic air pressure. Data indicate that the higher the initial pressure, the greater the permissible supersaturation value. From the overall study results, it was concluded that the differential coefficient should be used for calculating decompression routines. M.G.J

N66-17131* Israel Program for Scientific Translations, Ltd., Jerusalem.

SOME CONDITIONS FOR THE INCREASE IN BODY RESISTANCE TO DECOMPRESSION DISORDERS UNDER THE REPEATED EFFECTS OF DECOMPRESSION [O NEKOTORYKH USLOVIYAKH POVYSHENIYA USTOICHIVOSTI ORGANIZMA K DEKOMPRESSIONNYM NARUSHENIYAM PRI POVTORNYKH VOZDEISTVIYAKH DEKOMPRESSII]

V. A. Aver'yanov *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 34–39 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

The possibility of increasing body resistance to decompression disorders by frequently repeated decompressions was examined. In experiments conducted to determine the safe supersaturation coefficient (SSC) with nitrogen, dogs were kept 4 to 6 hours under increased pressure known to be safe, and then subjected to rapid decompression to the surface level. Results showed that repeated decompression from pressures, at which decompression disorders occur, does not increase body resistance; in fact, it may even decrease it. The initial use of high pressures exceeding the threshold has an even less favorable effect on body resistance. It was concluded that the optimum condition for increased body resistance is the initial application of a safe pressure, a gradual increase in it, and a drop to a lower pressure after decompression symptoms develop. M.G.J.

N66-17132* Israel Program for Scientific Translations, Ltd., Jerusalem.

PROVOCATION OF CAISSON DISEASE SIGNS IN ANIMALS EMERGING FROM INCREASED PRESSURE BY SUBSEQUENT ASCENT TO ALTITUDE [PROVOKATSIYA KESSONNYKH YAVLENII U ZHIVOTNYKH VYSHEDSHIKH IZ POD POVYSHENNOGO DAVLENIYA, PUTEM POSLEDUYUSHCHEGO POD'EMA IKH NA VYSOTU]

P. M. Gramenitskii and A. A. Savich *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 40–46 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Several experiments were performed to test the theory that gas bubble formation in the body after decompression under increased pressure can occur asymptomatically. In the studies, the animals were exposed to the effect of a rarified atmosphere at various periods after decompression from increased pressure. Use was made of increased pressures which were not followed by typical decompression disorders, and degrees of rarefaction which could not cause these disorders. The most interesting results were identified as those cases in which caisson symptoms rapidly developed during ascent to altitude, after the animal emerged from safe increased pressure. In explanation of this phenomenon, the supposition was advanced that prior to ascent gas bubbles had formed despite the absence of external symptoms of typical decompression disorders. It was concluded that gas bubbles may be formed and preserved for a long time in the body without functional disorders occurring; and that provocation of caisson disorders by ascent to altitude is a criterion of the presence of silent gas bubbles in the body, and the measure of its supersaturation with nitrogen. M.G.J.

N66-17133* Israel Program for Scientific Translations, Ltd., Jerusalem.

RESULTS OF EXPERIMENTAL ANALYSIS OF DECOMPRESSION AIR EMBOLISM [REZUL'TATY EKSPERIMENTAL'NOGO ANALIZA DEKOMPRESSIONNOI AEROEMBOLII]

P. M. Gramenitskii and A. A. Savich *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 47–56 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Several animal experiments were conducted to study the conditions which affect gas formation in the blood vessel, the sequence of gas bubble appearance in different blood vessels, and the physiological reactions which they induce. The resulting data confirmed that the air embolic process in the venous system represents the basic phenomenon in pathogenesis of overt decompression disorders. It was also found that when the body is considerably supersaturated with nitrogen for a comparatively long time after decompression (at 3.25 atm, 15 min), all conditions are present for gas formation in the artery. However, because of the rapid flow of the arterial blood, the gas bubbles in it usually do not increase to visible size. The idea of slow nitrogen diffusion in the lungs and tissues was identified as the most important experimental finding, and verification of this theory was recommended. M.G.J.

N66-17134* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE EFFECT OF DIFFERENT GASES ON THE ORGANISM AFTER INTRAVENOUS ADMINISTRATION [DEISTVIE NA ORGANIZM RAZLICHNYKH GAZOV PRI IKH VNUTRI VENNOM VVEDENII]

P. M. Gramenitskii, A. A. Savich, and K. S. Yurova *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 57–63 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Injections of carbon dioxide, oxygen, air, and a helium-oxygen mixture were introduced into the auricular veins of rabbits to study respiratory and circulatory reactions. It was found that the changes which occur are similar to decompression symptoms, and the point was made that the artificial air embolism can constitute an experimental model for general decompression disorders. Data also showed: (1) The body suffered

most severely from the nitrogen intravenous injection; tolerated helium appreciably better; oxygen, even better; and carbon dioxide easily. This is explained by the different diffusion capacities of each and, in the case of oxygen and carbon dioxide, by their possible chemical combination in the body. (2) The results of artificial air embolism depend to a great degree on the diffusion relationships created in the lungs between the air and the gas mixture filling the alveoli. Consequently, in eliminating air emboli, the leading part is played by diffusion of their constituent gases from the pulmonary vessels into the alveoli. M.G.J.

N66-17135* Israel Program for Scientific Translations, Ltd., Jerusalem.

TRAINING OF THE ORGANISM FOR ARTIFICIAL AIR EMBOLISM [TRENIROVKA ORGANIZMA K ISKUSSTVENNOI AEROEMBOLII]

P. M. Gramenitskii and K. S. Yurova *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 64–70 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

The possibility of increasing body resistance to air embolism was studied by means of regularly repeated intravenous injections of air into animals. Dosages necessary to produce initial, very transitory functional changes; overt disorders; and irreversible disorders and death were determined. Details are given on the experiments, and the tabulated data show an increased resistance to the harmful effect of air embolism as a result of repeated regular air injections, starting with comparatively small doses (0.6 ml). The rabbits acquired the capacity of tolerating doses of 1.0, 1.5, and even 2 ml equally well; several animals withstood an injection of over 4 ml, showing a tolerance for quantities known to be lethal. Experiments were performed to determine how quickly the body eliminated air emboli introduced into the blood. Results indicate that after many days' training with air injection, the rabbits showed no functional disorders in the ascent to altitude even after a short interval (45 min to 1 hour) between injection and ascent. It was concluded that such training enables the body to rapidly eliminate injected air emboli. M.G.J.

N66-17136* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE ROLE OF THE HYPOXEMIC FACTOR IN DEVELOPMENT OF DECOMPRESSION DISORDERS [O ROLI GIPOKSEMICHESKOGO FAKTORA V RAZVITII DEKOMPRESSIONNYKH RASSTROISTV]

P. M. Gramenitskii and A. A. Savich *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 71–75 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Studies were conducted to determine the blood gases in animals exposed to the effect of increased pressure and subsequent decompression, and also to artificial air embolism. Experimental procedures are detailed; and changes in the gas content of the arterial blood in dogs, with the development of caisson disease symptoms, are tabulated. Findings indicated that the onset of severe forms of decompression disorders is always accompanied by a pronounced hypoxemia and hypercapnia; hypoxemia and hypercapnia result from air embolism in capillaries of the lesser circulation; changes in the gas content (oxygen and carbon dioxide) of the arterial blood are an inseparable component of the body's reaction to decompression; and reduced oxygen content of the arterial blood in animals exposed to subliminal increased pressures usually occurs in the absence of typical decompression symptoms. M.G.J.

N66-17137* Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIMENTAL AIR EMBOLISM UNDER CONDITIONS OF HYPOTHERMIA AND HYPERTHERMIA [EKSPERIMENTAL'NAYA AEROEMBOLIYA V USLOVIYAKH GIPOTERMII I GIPERTERMII]

V. A. Aver'yanov and K. S. Yurova *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 76–83 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

The question of how altered temperature conditions affect the development of air embolism, and the resistance of the body to its deleterious influence, is examined. Experimental results showed increased resistance of overheated and particularly overcooled animals to air embolism; and some changes of the body in a state of hyper- or hypothermia to intravenous air injection. The differences of these resistance mechanisms are defined: in hyperthermia they consist chiefly of reactions which contribute to a more rapid removal of air bubbles from the blood stream. It is also pointed out that in hypothermia, reduced sensitivity of the central nervous system to unfavorable reflex influences caused by gas bubble, and to hypoxemia accompanied by air embolism, is of major importance. M.G.J.

N66-17138* Israel Program for Scientific Translations, Ltd., Jerusalem.

COMPARATIVE CHARACTERISTICS OF RESPIRATORY AND CIRCULATORY REACTIONS OF UNANESTHETIZED DOGS TO DECOMPRESSION AND ARTIFICIAL AIR EMBOLISM [SRAVNITEL'NAYA KHARAKTERISTIKA REAKTSII DYKHANIYA I KROVOOBRASHCHENIYA NENARKOTIZIROVANNYKH SOBAK NA DEKOMPRESSIONNUYU I ISKUSSTVENNUYU AEROEMBOLIYU]

V. I. Arsen'eva, P. M. Gramenitskii, and K. S. Yurova *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 84–91 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Frequently repeated long-term experiments were conducted on respiratory and cardiovascular reactions of unanesthetized animals to decompression and artificial air embolism. Studies were also undertaken to determine whether training for artificial air embolism is effective with respect to decompression, and, conversely, whether increased resistance to the decompression effect results in increased resistance to intravenous injection of several gases simultaneously. Data show similar respiratory and cardiac activity changes in intact animals under the effect of decompression and intravenous air injection. In both cases, dyspnea always occurs with greater or lesser increase in pulmonary ventilation, and the pulse usually slows. Results also indicate: (1) Training the organism for artificial air embolism increases its resistance to the effects of decompression; likewise, training for decompression effects increases resistance to intravenous gas injection. (2) Increased body resistance to decompression effects when they are repeated frequently is based, in part, on the perfection of respiratory and cardiovascular reactions produced by air embolism. M.G.J.

N66-17139* Israel Program for Scientific Translations, Ltd., Jerusalem.

SIMPLE "CALCULATED TISSUE" MODELS [PROSTYE MODELI "RASCHETNOI TKANI"]

V. A. Livshits *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 92–95 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

A method of calculating continuous decompression conditions is presented, based on an equation for the voltage at the capacitor of an RC circuit. An analysis was also made of the

conditions under which the permissible supersaturation coefficient (ratio of gas tension in the leading tissue to the total pressure), or the degree of permissible supersaturation (difference between gas tension in the leading tissue and the total pressure) remain constant. In this technique, the RC circuit is an electric analogy of the calculated tissue, in that the saturation and desaturation processes of the tissue with the gas and the charge on the capacitor are mathematically identical. The electric analogy permitted construction of an electronic model of the tissues of a diver. Periodic trapezoidal voltage pulses are fed, simulating descent or ascent of a diver to a certain depth and stay at the depth; the voltage in the capacitors is observed on the oscillograph. Electrical analogies are given for all magnitudes and processes connected with calculating decompression conditions. Also discussed is the application of a simple hydraulic model for successive chemical reactions to simulate saturation of the calculated tissue with an indifferent gas. M.G.J.

N66-17140* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE MECHANISM OF RESPIRATORY AND CIRCULATORY CHANGES IN DOGS UNDER THE INFLUENCE OF HIGH OXYGEN PRESSURES [K MEKHANIZMU IZMENENII DYKHANIYA I KROVOOBRASHCHENIYA U SOBAK PRI DEISTVII VYSOKIKH DAVLENII KISLORODA]

P. M. Gramenitskii and P. A. Sorokin *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 96–111 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Experimental studies were undertaken to examine the dynamics and mechanism of respiratory and circulatory changes during oxygen poisoning. Changes in pulse, blood pressure, respiration, and pulmonary ventilation are recorded. Four periods of significant change are identified: (1) the initial period characterized by reduced pulmonary ventilation and slowing of cardiac activity; (2) the preconvulsive period expressed in hyperventilation, tachycardia, and increased arterial blood pressure; (3) the convulsive period marked by gradual slowing of the heart rate; and (4) the terminal period distinguished by a sudden replacement of parasympathetic by sympathetic reactions, with rapid rise in blood pressure and increased heart rate. Also described are procedures performed on various nerves to determine their part in the development of circulatory reactions at various stages of oxygen poisoning. Data indicate that bilateral vagotomony in the second or preconvulsive period had no appreciable effect; conversely, cutting a cardiac branch of the sympathetic nerve resulted in reduced blood pressure and decreased cardiac contractions. M.G.J.

N66-17141* Israel Program for Scientific Translations, Ltd., Jerusalem.

PATHOLOGICAL CHANGES IN THE LUNGS OF ANIMALS UNDER THE INFLUENCE OF HIGH OXYGEN PRESSURES [O PATOMOREFOLOGICHESKIKH IZMENENIYAKH V LEGKIKH U ZHIVOTNYKH PRI DEISTVII VYSOKIKH DAVLENII KISLORODA]

M. A. Groshikov and P. A. Sorokin *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 112–121 refs (See N66-17126 07–04) CFSTI: HC $6.00/MF $1.75

Several animal experiments were conducted to study the pathological characteristics in acute oxygen poisoning, and the mechanism of pulmonary involvement due to increased oxygen pressures. Results of autopsy and histological examination of the internal organs of guinea pigs and dogs exposed to high oxygen pressures showed similar pathological changes in both. In dogs pulmonary blood vessel congestion was more pronounced, however; and there was no eosinophilic infiltration of the alveolar septa or peribronchial tissue. Pathological changes in the lungs were identified as dilation and congestion of the veins and capillaries, sometimes with hemorrhages into the surrounding tissues and alveoli; perivascular edema; thickening of the alveolar septa; and development of different degrees and magnitudes of atelectasis. Pulmonary involvement was associated with a more or less pronounced congestion of other internal organs. It was also found that isolation of the suprarenal glands in dogs, when combined with cutting of the splanchnic nerves, was accompanied by less pronounced pathological changes in the lungs. The importance of humoral factors in the development of pulmonary involvement was emphasized. M.G.J.

N66-17142* Israel Program for Scientific Translations, Ltd., Jerusalem.

CHANGES IN THE ELECTRICAL ACTIVITY OF THE HEARTS OF ANIMALS UNDER THE INFLUENCE OF HIGH OXYGEN PRESSURE [IZMENENIYA ELEKTRICHESKOI AKTIVNOSTI SERDTSA U ZHIVOTNYKH PRI DEISTVII VYSOKIKH DAVLENII KISLORODA]

P. A. Sorokin *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 122–132 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Several experiments were conducted to determine the electrical activity of the heart in intact animals, and to study the developmental dynamics of acute oxygen poisoning. Results show that a distinct reduction of the heart rate occurs at the beginning of high oxygen pressures, along with an SA block and an AV conduction disorder (in guinea pigs). The convulsive period is characterized by heart block; the terminal period, by sinus tachycardia (in dogs), which after respiratory arrest is again replaced by bradycardia and complete AV block. Data also indicated that (1) Preliminary atropinization or cutting of the vagus nerves eliminated slowing of the heart rate, SA block and AV conduction disorder in the initial and convulsive periods, but did not prevent heart block. (2) Cardiac arrhythmias and other changes in the electrical activity of the heart during the convulsive period were transitory and disappeared rather quickly when the high oxygen pressures were discontinued. M.G.J.

N66-17143* Israel Program for Scientific Translations, Ltd., Jerusalem.

CHANGE IN THE CIRCULATING BLOOD VOLUME IN DOGS BREATHING OXYGEN UNDER PRESSURES OF 1.0 AND 2.0 ATMOSPHERES [IZMENENIE KOLICHESTVA TSIRKULIRUYUSHCHEI KROVI U SOBAK PRI DYKHANII KISLORODOM POD DAVLENIEM 1.0 I 2.0 ATA]

P. A. Sorokin *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 133–139 refs (See N66-17126 07–04) CFSTI: HC $6.00/MF $1.75

Compression chamber experiments were conducted to investigate the factors involved in circulating blood volume, particularly under increased oxygen pressures. In control studies performed when the animals were breathing ordinary air, the volume of circulating plasma was, on the average, 47.3 ml/kg body weight; the circulating blood volume averaged 84.4 ml/kg. During the breathing of oxygen under ordinary atmospheric pressure, the quantity of circulating plasma averaged 41.8 ml/kg; circulating plasma volume averaged 75.8 ml/kg. Under an oxygen pressure of 2.0 atm, the quantity of circulating blood plasma averaged 48.1 ml/kg; the circulating blood volume, 79.7 ml/kg. From the data, it was concluded that in dogs breathing oxygen at pressures of 1 and 2 atm, a

reduction of the circulating plasma and blood volume occurs; and that this reduction should be regarded as an adaptive reaction to an increased partial oxygen pressure in the inhaled air. M.G.J.

N66-17144* Israel Program for Scientific Translations, Ltd., Jerusalem.

CHANGE IN THE ADSORPTIVE PROPERTIES OF THE NERVOUS SYSTEM AND INTERNAL ORGANS OF WHITE MICE DURING OXYGEN-INDUCED CONVULSIONS [IZMENENIE SORBTSIONNYKH SVOISTV NERVNOI SISTEMYI I VNUTRENNIKH ORGANOV BELYKH MYSHEI PRI SUDOROZHNOM DEISTVII KISLORODA]

L I. Aruin and M. G. Ryff *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 140–147 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Pressure chamber experiments are described in which intravital staining of both isolated organs and the intact organism was used to demonstrate the occurrence of fine material changes in the central nervous system and some internal organs due to increased oxygen pressure. Tests were conducted to study the absorptive power of the tissues under the toxic influence of oxygen in the preconvulsive period; the adsorptive power of animal organs after suffering convulsive paroxysms at a pressure of 4.2 atm; and the stainability of organs in the postconvulsive phase. It was found that a phasic change occurred in intravital stainability of the central nervous system and suprarenal glands. A quantitative evaluation of these changes showed that in the preconvulsive period, the absorptive power of the brain is reduced; during the convulsions such power increases considerably; and in the postconvulsive period a reduction re-occurs; the cerebral cortex showed the greatest changes. Data on the adsorptive properties of the suprarenal gland indicate that the development of oxygen poisoning is accompanied by distinct changes in dye absorption at various phases of the toxic effect of oxygen. M.G.J.

N66-17145* Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIENCE IN THE COMPREHENSIVE STUDY OF THE CONDITION OF SOME SYSTEMS OF THE HUMAN BODY UNDER INCREASED OXYGEN PRESSURE [OPYT KOMPLEKSNOGO IZUCHENIYA SOSTOYANIYA NEKOTORYKH SISTEM ORGANIZMA CHELOVEKA V USLOVIYAKH POVYSHENNOGO DAVLENIYA KISLORODA]

G. L. Zal'tsman, I. D. Zinov'eva, S. D. Kumanichkin, and A. V. Turygina *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 148–155 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Dry compression chamber experiments were conducted on three divers to study the functions of the motor, cardiovascular, respiratory, and central nervous systems, under the initial toxic effect of oxygen. Procedures included electroencephalographic tracings; recording of heart and respiratory rates, and blood pressure; higher nervous activity tests; and electromyographic recordings. Studies were initially made in a chamber under ordinary conditions, while breathing air, and then every half-hour while under pressure. Each subject was exposed twice to the effect of increased oxygen pressure. The clinical manifestations of the toxic effect of oxygen indicated disorders of the autonomic nervous system functions; these occurred after approximately 1-1/2 to 2 hours of exposure. It was pointed out that a number of latent changes were detected as early as the first few minutes under increased oxygen pressure; the greatest changes were found in the visual and auditory analyzers, but the complex behavioral reactions were retained. M.G.J.

N66-17146* Israel Program for Scientific Translations, Ltd., Jerusalem.

METHOD OF DETERMINING THE HEMODYNAMIC INDICES IN LONG-TERM EXPERIMENTS ON DOGS UNDER A HIGH PARTIAL PRESSURE OF OXYGEN (IN A PRESSURE CHAMBER) [K METODIKE OPREDELENIYA GEMODINAMICHESKIKH POKAZATELEI V KHRONICHESKIKH OPYTAKH NA SOBAKAKH PRI VYSOKOM PARTSHAL'NOM DAVLENII KISLORODA (V BAROKAMERE)]

N. Ya. Sidorov *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 156–163 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Experimental methods for determining hemodynamic changes in dogs subjected to high pressure conditions for long periods of time are described. The general procedure used for recording the processes of the cardiovascular system is outlined. Diastolic and lateral systolic blood pressure; the rate of pulse wave propagation (as an index of the tone in the large artery); and the pulse and respiratory rates (by electrocardiogram) were recorded. A tacho-oscillographic method and a carbon contact pick-up method for recording the blood pressure are described. On the basis of data obtained, the derivatives of the hemodynamic indices of stroke volume, minute volume, and peripheral resistance can be calculated. L.S.

N66-17147* Israel Program for Scientific Translationsy Ltd., Jerusalem.

THE BLOOD AND SPINAL FLUID SUGAR, LACTIC ACID, AND INORGANIC PHOSPHORUS IN DOGS WITH HYPEROXEMIC AND HYPOXEMIC CONVULSIONS [SODERZHANIE SAKHARA, MOLOCHNOI KISLOTY I NEORGANICHESKOGO FOSFORA V KROVI I SPINNOMOZGOVOI ZHIDKOSTI U SOBAK PRI GIPERO- I GIPOKSEMICHESKIKH SUDOROGAKH]

A. F Panin *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 164–169 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

The effect of hyperoxemic and hypoxemic convulsions on the sugar, lactic acid, and inorganic phosphorus contents of the blood and spinal fluid of dogs was investigated. The convulsions were studied in increased and reduced atmospheric pressure chambers. The data are presented in tabular form, and indicate that both hyperoxemic and hypoxemic convulsions are characterized by a considerable increase in the blood lactic acid. In the former case the increase is brought about by interference with tissue oxygen utilization; in the latter case, by reduction of the oxygen tension in the tissues. The blood sugar content of the dogs with both types of convulsions is markedly increased. The blood inorganic phosphorus in dogs with hyperoxemic convulsions is distinctly elevated; but in hypoxemic conditions the phosphorus level remains unchanged or is somewhat reduced. L.S.

N66-17148* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE TYPOLOGY OF HIGHER NERVOUS ACTIVITY CHARACTERISTICS IN DOGS UNDER BAROMETRIC PRESSURE CHANGES [TIPOLOGICHESKIE OSOBENNOSTI VYSSHEI NERVNOI DEYATEL'NOSTI SOBAK PRI IZMENENII BAROMETRICHESKOGO DAVLENIYA]

V. N. Zvorykin *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 170–177 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

The nature and degree of changes in higher nervous activity of dogs under the influence of rarefied air and anoxia were studied by means of experiments performed in a high pressure chamber with rarefied air. The investigation was made

by using the conditioned salivary reflexes of the dogs to food, and other positive conditioned stimuli reflexes. Tests were performed involving starvation, caffeine, bromine, powerful stimuli effects, extension of the positive conditioned reflex, prolongation of the action of the differentiating stimulus, change in the biological significances of the positive and inhibitory conditioned stimuli, and a check on the dynamic stereotype with an indicator stimulus. The experimental data are discussed. They indicate that there is a definite relationship between the nature and degree of changes in nervous activity in dogs under air rarefraction, and the basic characteristics of their nervous processes. The type of nervous activity affects the changes, along with other factors which are also analyzed. L.S.

N66-17149* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE EFFECT ON HIGHER NERVOUS ACTIVITY OF DOGS OF ACUTE HYPOXEMIA PRODUCED BY RAREFACTION OF THE ATMOSPHERE TO AN ALTITUDE OF 18,000 METERS [VLIYANIE OSTROI GIPOKSEMII, VYZVANNOI RAZREZHENIEM ATMOSFERY DO VYSOTY 18,000 M, NA VYSSHUYU SOBAK]

B. A. Vinokurov and Zan Dok Men *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 178–195 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Dogs were subjected to conditions of atmospheric rarefaction corresponding to an altitude of 18 000 m for determining the effect of acute hypoxemia on their nervous activity. Various experimental situations were conducted, and the behavior of the dogs reactions to petting, danger, painful, audio, and photic stimuli were observed. Motion picture frames showing the dogs responding to the stimuli are shown. The observations tend to advance the idea that the stability of conditioned reflexes in the presence of strong external factors is determined by their biological significance for the organ experiencing the unusual effects. Under ordinary feeding conditions, the ascents up to 18 000 m in the pressure chamber, leading to the development of marked hypoxemia, are accompanied by the rapid formation of motor defense conditioned-reflex reactions to the situation and complete inhibition of the natural reflexes to food. After 1 to 2 months of being only in the pressure chamber, the animals maintain positive reactions to the experimental situation and to food stimuli, despite subsequent repeated ascents in the chamber to the same altitude, accompanied every time by a very severe anoxia. L.S.

N66-17150* Israel Program for Scientific Translations, Ltd., Jeri salem.

THE DEVELOPMENT OF DINITROPHENOL-INDUCED HYPERTHERMIA UNDER ALTERED PARTIAL PRESSURES OF OXYGEN AND CARBON DIOXIDE [RAZVITIE DINITROFENOLOVOI GIPERTERMII PRI IZMENENNYKH PARTSIAL' NYKH DAVLENIYAKH KISLORODA I UGLEKISLOTY]

A. A. Savich *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 196–204 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Dinitrophenol, DNP, solutions were injected into the auricular veins of both male and female rabbits for the purpose of inducing hyperthermia in the animals. The rabbits were then placed in a vacuum chamber and raised to a simulated height of 5,500 m where they were kept for 1 hr to determine the influence of reduced partial oxygen pressure on the animals. A total of 77 experiments on 63 rabbits were performed in which the pressures of oxygen and carbon dioxide were varied. Control experiments were included. The data indicate that the change in partial oxygen pressure exerts a very pronounced effect on the development of DNP-induced hyperthermia. The experiments also showed that after DNP administration, the rabbits have an altered tolerance to the effect of altered partial oxygen and carbon dioxide pressures. Under an atmosphere of compressed oxygen, a very marked acceleration in the course of the hyperthermic reaction of the DNP injection occurs. Other observations are noted; and tables of the data obtained are given. L.S.

N66-17151* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE EFFECT ON THE BODY OF A PROLONGED STAY IN A GAS MEDIUM WITH AN INCREASED CARBON DIOXIDE CONTENT [VLIYANIE NA ORGANIZM DLITEL'NOGO PREBYVANIYA V GAZOVOI SREDE S POVYSHENNYM SODERZHANIEM UGLEKISLOTY]

T. N. Zheludkova, V. P. Zagryadskii, and Z. K. Sulimo-Samuillo *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 205–211 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Experiments were performed on 42 rabbits in a gas pressure chamber to study the effect of air mixtures containing increased carbon dioxide content on the breathing of the animal organism. Electroencephalographic and electrocardiographic recordings were made. The data indicate that after the animals had been in gaseous mediums with 3% or 5% carbon dioxide content, pronounced functional changes were observed in respiration, the cardiovascular system, and the central nervous system, agreeing with data from the literature. A rapid switch of animals from a medium with an increased carbon content to ordinary atmospheric air left marked aftereffects on the animals fasting 1.5 to 2 hrs. The aftereffect period is considerably reduced (to 30 min) and is accompanied by less pronounced functional changes when the 5% carbon dioxide content is mixed with 35% to 40% oxygen. Other observations are also noted, and discussed. L.S.

N66-17152* Israel Program for Scientific Translations, Ltd., Jerusalem.

ADAPTIVE REACTION OF THE HUMAN BODY TO THE REPEATED EFFECTS OF INCREASED AIR PRESSURE (ACCORDING TO DATA ON THE STUDY OF HIGHER NERVOUS ACTIVITY) [PRISPOSOBITEL'NAYA REAKTSIYA ORGANIZMA CHELOVEKA K POVTORNOMU DEISTVIYU POVYSHENNYKH DAVLENII VOZOUSHNOI SREDY (PO DANNYM IZUCHENIYA VYSSHEI NERVNOI DEYATEL'NOSTI)]

B. A. Nessirio *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 212–219 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

A study was made of the dynamics of higher nervous activity indices of subjects, aged between 19 and 30, repeatedly exposed to conditions of increased air pressures (4 atm to 8 atm) in a dry pressure chamber for evaluating their body adaptive reactions. The data are given in tabular form and are discussed. Relative normalization of the indices occurs in the majority of cases after 3 to 5 descents. The nature of the reactions depended on the degree of disorder of the nervous activity under pressure. The greater the pressure, the more sensitive the subject to the anaesthetic effect of nitrogen; and the more difficult the task, the more pronounced were the changes in higher nervous activity and the greater were the number of repeated descents necessary for relative normalization of them. Training sessions against the initial anaesthetic effect of nitrogen in divers permit an increase in the output of their work under increased pressure. L.S.

N66-17153* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE PROBLEM OF THE MECHANISM OF OCCURRENCE OF PULMONARY PRESSURE TRAUMA DURING THE BREATHING OF AIR AND OXYGEN [K VOPROSU O MEKHANIZME VOZNIKNOUENIYA BAROTRAVMY LEGKIKH PRI DYKHANII VOZDUKHOM I KISLORODOM]

Yu. M. Polumiskov *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 220–227 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Experiments were performed on cats and dogs of both sexes for studying the mechanism of the occurrence of pulmonary pressure trauma during their breathing. Blood pressure, respiration, intrapleural pressure, intra-pulmonary pressure and time marking were recorded on a kymograph. The results of the experiments are tabulated and discussed. The data indicate that pneumothorax always occurs in dogs and cats when the intrapulmonary pressure is increased from 10 mm to 60 mm Hg, most often between 20 mm and 40 mm Hg. Increase in the duration of action of intrapulmonary pressure causes pressure trauma of the lungs at lower pressures. In some cases, visible arterial gas embolism occurs during the trauma when the pressure is raised above 60 mm Hg and is accompanied by the simultaneous entrance of a large number of gas bubbles into the left heart and the arteries of the entire body of the animal. The nature of the gas mixture breathed is of no essential importance in the occurrence mechanism of pulmonary pressure trauma or accompanying arterial gas embolism. L.S.

N66-17154* Israel Program for Scientific Translations, Ltd., Lerusalem.

THE PROBLEM OF THE EFFECT OF BREATHING OXYGEN IN THE RESORPTION OF GAS EMBOLI IN THE VASCULAR SYSTEM OF AN ANIMAL AND ON THE COURSE OF PULMONARY PRESSURE TRAUMA [K VOPROSU O VLIYANII DYKHANIYA KISLORODOM NA RASSASYVAEMOST' GAZOVYKH EMBOLOV V KROVENOSNOI SISTEME ZHIVOTNOGO I TECHENIE BAROTRAVMY LEGKIKH]

Yu. M. Polumiskov *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 228–233 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Seventeen experiments were performed on cats to determine the effect of breathing oxygen on resorption of gas bubbles in the blood vessels with pulmonary pressure trauma. The experiments were conducted in three groups: in one group, the animals were switched to breathing oxygen 30 to 50 min before beginning the increase in intrapulmonary pressure; in another group pulmonary pressure trauma with arterial gas embolism was produced with air; and for the remaining experiments pulmonary pressure trauma was produced with air alone. The results show that resorption of the gas bubbles occurs more rapidly in animals breathing oxygen than in those breathing air. The change in the number of gas bubbles in the cannula trap essentially corresponded to the nature of changes in gas emboli in the animal's blood vessels. The experiments performed with creation of pulmonary pressure trauma and arterial gas embolism permitted a determination of the effect of the nature of the gas mixture being breathed on the course of the disorder. C.T.C.

N66-17155* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE PROBLEM OF TREATMENT OF PULMONARY PRESSURE TRAUMA [K VOPROSU O LECHENII BAROTRAVMY LEGKIKH]

Yu. M. Polumiskov *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 234–238 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

Because therapeutic recompression is often impossible or too delayed in treating pulmonary pressure trauma, a method to alleviate this condition before recompression was studied. Experiments were performed on cats of both sexes to study the effect of active removal of excess gas from the intrapleural space into which the gas entered through rupture of the lung tissue. The gas was sucked out with a syringe through the side arm of a rubber tube connected into the system for recording the intrapleural pressure. Positive results were obtained with the method and they are explained by the fact that with the occurrence of pulmonary pressure trauma, the gas enters the pleural cavities, mediastinal tissue, tissue of the retroperitoneal space, and other organs. By suction, the gas is removed from the interpleural spaces of both lungs, and probably a certain quantity from the mediastinal tissue. The suction evidently creates a negative pressure in the interpleural cavity. The ruptured part of the lung is appressed against the parietal pleura and subsequently the lung can function again under near normal conditions. Removing the excess gas not only eliminates the mechanical impediment to cardiovascular activity, but also reduces the strength of internal organ receptor stimulations, which also has a positive effect. R.N.A.

N66-17156* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE ROLE OF PROPRIOCEPTIVE IMPULSES FROM THE CHEST AND ABDOMINAL MUSCLES IN THE REACTIONS OF THE BODY DURING RESPIRATION UNDER INCREASED INTRAPULMONARY PRESSURE [ROL' IMPUL'SOV S PROPRIORETSEPTOROV GRUDNOI KLETKI I MYSHTS ZHIVOTA V REAKTSIYAKH ORGANIZMA PRI DYKHANII POD POVYSHENNYM DAVLENIEM V LEGKIKH]

P. V. Oblapenko *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 239–248 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

The role of increased proprioceptive impulses from the chest and abdominal muscles in regulating respiration and circulation with increased intrapulmonary pressure was studied. The study showed that during respiration under increased intrapulmonary pressure, the exclusion of propricoceptive impulses by severing the posterior columns of the spinal cord of dogs causes tone and contraction reduction of respiratory muscles. The reduced tone of respiratory muscles and their asynchronous activity after supplementary vagotomy is markedly expressed. The sharp reduction of abdominal muscle tone observed after severing the spinal cord posterior columns and supplementary vagotomy, causes a decrease in the blood pressure level. During respiration under increased intrapulmonary pressure, recovery from the initial hemodynamic disorders is slow or does not occur, and the pressure in the right ventricle increases significantly. During respiration under increased intrapulmonary pressure in which proprioceptive impulses were cut, a supplementary high or low vagotomy causes the same circulatory disorders. This indicates that the basic factor causing these disorders is the decrease of blood flow to the right ventricle due to the sharp reduction of abdominal muscle tone, and the exclusion of the sucking effect of the thorax during inspiration. R.N.A.

N66-17157* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE CONDITION OF VASCULAR REFLEXES IN DOGS DURING RESPIRATION UNDER INCREASED INTRAPULMONARY PRESSURE [SOSTOYANIE SOSUDISTYKH REFLEKSOV U SOBAK PRI DYKHANII POD POVYSHENNYM DAVLENIEM V LEGKIKH]

P. V. Oblapenko *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 249–257 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

The nature of changes in the carotid sinus pressor and depressor reflexes in dogs during respiration under increased intrapulmonary pressure was investigated along with their effect on the body's adaptive reactions under these conditions. The study showed that during breathing under increased intrapulmonary pressure, the carotid sinus pressor and depressor reflexes in dogs decrease. The depressor reflex is more variable. The degree of reflex reduction depends on the blood pressure level in the greater circulation, which is determined by the tone of the vasoconstrictor center. With a low blood pressure, as well as after atropinization of animals or vagotomy, the pressor carotid sinus reflex is minimal and the depressor effect may disappear completely or even be distorted. During the blood pressure reduction in the greater circulation, there is an irradiation of excitation from the vasomotor to the respiratory center, which is in an inhibited state. This contributes to a more rapid recovery of respiration in the initial period after an increase of intrapulmonary pressure. R.N.A.

N66-17158* Israel Program for Scientific Translations, Ltd. Jerusalem.

THE ROLE OF THE VAGUS NERVES IN THE BODY REACTIONS DURING BREATHING UNDER INCREASED INTRAPULMONARY PRESSURE [O ROLI BLUZHDAYUSHCHIKH NERVOV V REAKTSIYAKH ORGANIZMA PRI DYKHANII POD POVYSHENNYM DAVLENIEM V LEGKIKH]

P. V. Oblapenko *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 259–267 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

A detailed study was made of the role of the vagus nerves in the circulatory and respiratory reactions during increased intrapulmonary pressure. Under increased intrapulmonary pressure, dogs showed respiratory inhibition and a reduced heart rate, contributing to a drop in blood pressure in the greater circulation due to afferent vagus nerve impulses coming from the mechanoreceptors of the lungs and other thoracic organs. The blood pressure stability which occurs is effected by a number of reflexes. The vagus nerves constitute the afferent component of the reflex arc in this process. The parasympathetic fibers coming to the heart through the vagus nerves inhibit the cardiac contraction rates, increase the duration of diastole, and reduce cardiac fatigue during respiration under increased pressure. Low vagotomy results in a reduction of abdominal muscle tone, a deterioration of venous inflow into the right ventricle, and a slower compensation for the hemodynamic changes caused by increased intrapulmonary pressure. High vagotomy, which causes a disruption of the reflex regulation of cardiac activity, produces an impoverishment of the animals tolerance to breathing under increased pressure. R.N.A.

N66-17159* Israel Program for Scientific Translations, Ltd., Jerusalem.

RESPIRATORY AND CARDIOVASCULAR REFLEXES FROM GASTROINTESTINAL MECHANORECEPTORS IN BAROMETRIC PRESSURE CHANGES [REFLEKSY S MEKHANORETSEPTOROV ZHELUDOCHNOKISHECHNOGO TRAKTA NA DYKHANIE I SERDECHNOSOSUDISTUYU SISTEMU PRI PEREPADAKH BAROMETRICHESKOGO DAVLENIYA]

V. N. Zvorykin, A. A. Koreshkov, and P. A. Mal'kov *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 268–278 refs (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

An investigation was conducted on respiratory and cardiovascular reflexes from gastrointestinal mechanoreceptors resulting from expanding gas in the gastrointestinal tract during barometric pressure changes. An increase in the gastrointestinal tract gas volume along with a decrease in barometric pressiure causes a change in the frequency and depth of respiration, in the volume of pulmonary ventilation, in pulse rate, and in the strength of cardiac contraction and blood pressure. The degree and nature of these changes depend on the pressure on the gastrointestinal wall. Respiratory and circulatory changes occurring from expanding gas in the gastrointestinal tract during a barometric drop depend on the mechanism of visceral reflexes from the mechanoreceptors of the stomach and intestines, and on the mechanical effects on the diaphragm, position of the heart, and the lumina of abdominal vessels. The vagus and splanchnic nerves and nerve plexuses of the abdominal cavity are involved in these reflexes. R.N.A.

N66-17160* Israel Program for Scientific Translations, Ltd., Jerusalem.

CASE OF LATE MANIFESTATION OF INTRAPULMONARY PRESSURE [SLUCHAI POZDNEGO PROYAVLENIYA BAROTRAVMY LEGKIKH]

N. A. Afanas'ev and Z. S. Gusinskii *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 279–281 (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

A latent case of intrapulmonary pressure trauma with gas embolism, its symptoms, its diagnosis, and its treatment are described. After surfacing too quickly, a diver suffered no ill effects for 16 to 18 hours. Then, he began to complain of chest pains on deep inspiration and muscular pains in his arms and chest. During the next three days he developed headache, dizziness, weakness, dyspnea, and palpitations. A survey chest X-ray showed indistinct shadows of a gas layer in the supraclavicular areas, although temperature, blood pressure and pulse were normal. Finally, 92 hours after surfacing the diver was placed in a recompression chamber, from which he emerged several hours later complaining only of weakness and slight chest pains. After being held several days for observation, he was released in good condition. Based on these and other detailed observations, practical recommendations are made for prevention and treatment of future cases. D.T.

N66-17161* Israel Program for Scientific Translations, Ltd., Jerusalem.

SEVERE SPINAL FORM OF DECOMPRESSION SICKNESS WITH A FAVORABLE OUTCOME [TYAZHELAYA SPINAL'NAYA FORMA DECOMPRESSIONOI BOLEZNI S BLAGOPRIYATNYM ISKHODOM]

Z. S. Gusinskii and A. I. Shvarev *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 282–286 (See N66-17126 07-04) CFSTI: HC $6.00/MF $1.75

A case of severe spinal cord lesions in decompression sickness, its symptoms, its diagnosis, and its treatment are described. The sickness began following a training session in a recompression chamber. At first the diver complained of neck pains and formication in the lower regions; he next noted chest pains, and weakness and reduced sensitivity in the lower half of his body. After being replaced in the recompression chamber, his condition worsened; and he was finally removed to a hospital suffering paralysis in the lower extremities. During his several months of recovery, the diver was

treated for a number of complications, including infections and allergic reactions. Varied drugs were administered, i.e., antibiotics, nystatin, vitamins, aloe, protigmine, and dibazole. After prolonged treatment, he was discharged still suffering mild residual signs of paraparesis and reduced sensitivity in his legs. It is finally noted that the patient was predisposed to allergic reactions from various causes; and it is recommended that physicians consider this possibility in selection of diving candidates. D.T.

N66-17162* Israel Program for Scientific Translations, Ltd., Jerusalem.

INCREASED INDIVIDUAL PREDISPOSITION OF A SUBJECT TO THE EFFECT OF HIGH PARTIAL OXYGEN PRESSURE [O POVYSHENNOI INDIVIDUAL'NOI PREDRASPOLOZHENNOSTI ISPYTUEMOGO K OEISTVIYU VYSOKIKH PARTSIAL'NYKH DAVLENII KISLORODA]

G. L. Zal'tsman, I. D. Zinov'eva, and S. D. Kumanichkin *In its* Effect of the Gas Medium and Pressure on Body Functions, Collection III 1965 p 287–290 refs (See N66-17126 07–04) CFSTI: HC $6.00/MF $1.75

The toxic effects of high partial oxygen pressure on vision, and a means of preventing these effects are discussed. During a long term recompression test, a diver complained of cloudy vision. After emerging from the chamber, he was found to be suffering a severe restriction of the peripheral visual field. Complete recovery took 40 minutes. Animal studies, however, had already shown that oxygen's toxic effects could be lessened during recompression by occasionally breathing air instead of pure oxygen. Therefore following this routine, the diver was again subjected to an even longer recompression period. The symptoms, however, were considerably reduced in severity. Appropriate recommendations are made. D.T.

N66-17175# Brookhaven National Lab., Upton, N. Y. Biology Dept.

GALVANI, VOLTA AND BIOELECTRICITY

Leslie F. Nims [1965] 35 p refs Alexander Forbes Lecture, Marine Biol. Lab., Woods Hole, Mass., 9 Jul. 1965
(Contract AT(30-2)-GEN-16)
(BNL-9337) CFSTI: HC $2.00/MF $0.50

Developments in the field of bioelectricity since the studies of Galvani in 1794 are reviewed, with emphasis on the development of the voltaic pile, or galvanic cell, by Volta, and the formulation of the concept of a hypothetical difference in electrical potential across a membrane. It is stressed that in theoretical electrophysiology, account must be taken of the fact that equilibrium between phases separated by a membrane is the exception rather than the rule in biological systems; that a fundamental observation of bioelectricity is that electric currents flow; that the electric currents of interest are quasi-direct, or steady state currents in closed electrical circuits; and that there are no metallic electrodes or electrochemical reactions. Equations are presented that illustrate the thermodynamics of irreversible processes for material transfer across a membrane of constant thickness in which there is a difference in the chemical potential of neutral molecules or a difference in electrochemical potential of an ion between two homogeneous phases in contact with the barrier. A unit transfer system in a Sollner ring system is cited as an example, in which the system is regarded as two unit transfer systems containing barriers of different properties arranged in an electrical circuit. Applications of the theories discussed to the thermodynamics of material transfer across biological membranes are developed. NSA

N66-17176# Brookhaven National Lab., Upton, N. Y. Biology Dept.

MATERIAL TRANSFER, MEMBRANES AND METABOLISM

Leslie F. Nims [1965] 56 p refs Alexander Forbes Lecture, Marine Biol. Lab., Woods Hole, Mass., 8 Jul. 1965
(Contract AT(30-2)-GEN-16)
(BNL-9338) CFSTI: HC $3.00/MF $0.50

Thermodynamic principles involved in the transfer of ions across membranes are discussed on the basis of their applicability in studies of the flow of nutrients and excrements into and out of a biological system. It is pointed out that all living systems operate as open systems for the major fraction of their life span. The point is stressed that the motion of material substances through biological barriers appears to obey the same basic laws as the motion of proteins in a centrifuge, the sedimentation of cells in a test tube, or the motion of satellites in the atmospheric barrier. Theories of material transfer are developed by means of mathematical relations that apply physical-chemical concepts to biological processes. The details of the molecular traffic occurring in all biological barriers will be of interest to the experimentalist in that they lead to formal relations between metabolism and ion distribution patterns verifiable by experiment, and in some instances a quantitative prediction of the behavior of particular membranes. Applications of the theories in explaining the results of radioisotope tracer studies of membrane transfer are discussed briefly. NSA

N66-17218*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE ANOMERIC SPECIFICITY OF YEAST GALACTOKINASE

Sally M. Howard and M. R. Heinrich (Southern Calif. Univ.) [1964] 25 p refs
(Grant PHS G-A-5096)
(NASA-TM-X-56057) CFSTI: HC $1.00/MF $0.50 CSCL 06A

In order to investigate the specificity of yeast galactokinase toward the α and β anomers of galactose, a chromatographic system has been developed for separating the identifying α- and β-galactose-1-phosphates. The purified enzyme was incubated with β-galactose, and the phosphorylated product isolated and identified as α-Gal-1-P. Optical rotation studies show no mutarotase activity in the enzyme preparation; however, other components of the incubation mixture are shown to accelerate the mutarotation of β-galactose. Thus, while it cannot be stated conclusively that β-galactose cannot be phosphorylated by this enzyme, the absence of any β-Gal-1-P in the product confirms that α-galactose is the preferred substrate, and that the previously observed reaction of purified galactokinase with β-galactose probably consists of nonenzymatic mutarotation, followed by phosphorylation of the resulting α-galactose. Author

N66-17240*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MICROBIAL CONTAMINATION OF A SURFACE BY HANDLING

Edmund M. Powers Nov. 1965 12 p refs
(NASA-TM-X-55408; X-624-65-491) CFSTI: HC $1.00/MF $0.50 CSCL 06M

Stainless steel strips were used to determine the extent of microbial surface contamination due to handling. After sterilization, the strips were handled by various persons with freshly washed hands for different lengths of time in an attempt to discern what, if any, parameters were effective in contamination. It was noted that strips handled by persons who perspired heavily contained a microbe count several times

greater than strips handled by persons who did not tend to perspire. Other parameters, for which no conclusions were reached, included age, sex, weight, state of nutrition, type of diet, and pathological condition. D.T.

05 BIOTECHNOLOGY

Includes life support systems; human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N66-16192*# Naval School of Aviation Medicine, Pensacola, Fla.

THOUSAND AVIATOR STUDY: METHODOLOGY

Albert Oberman, Robert E. Mitchell, and Ashton Graybiel 22 Jul. 1965 178 p refs *Its* Monograph 11

(NASA Order R-136)

(NASA-CR-69895) CFSTI: HC $5.00/MF $1.00 CSCL 05I

The Pensacola study of Naval Aviators, commonly termed the "Thousand Aviator Study," began in July 1940 as a survey to validate techniques for pre-selecting pilot trainees in order to reduce the large attrition rate in the flight training program at that time. From this original exploratory study of pilot selection evolved a longitudinal study which has provided continuous physiologic information on a group of healthy males from youth to senescence. Re-examinations have been made on survivors of the group in 1951, 1957, and 1963. This Monograph purports to accomplish the following aims: (1) Present and unify the procedures and methods of all the examinations carried out on the group; (2) offer standard material for cooperative studies; (3) serve as a guide for future evaluation; (4) display the methodology employed in a fashion which lends itself to perusal by critical reviewers; (5) suggest by retrospection necessary modification; and (6) provide a basis for scrutinizing the material in search of new avenues of investigation. The material falls into the natural division of the four different examinations carried out to date, each chapter containing data regarding procedures and tests of a particular study. No findings of any of the evaluations are presented; for these the reader is referred to the Thousand Aviator Study Bibliography. Author

N66-16283*# Naval School of Aviation Medicine, Pensacola, Fla.

BIOTELEMETRY OF THE TRIAXIAL BALLISTOCARDIOGRAM AND ELECTROCARDIOGRAM IN A WEIGHTLESS ENVIRONMENT

W. Carroll Hixson and Dietrich E. Beischer 8 Sep. 1964 116 p refs *Its* Monograph No. 10

(NASA Order R-20)

(NASA-CR-69828) CFSTI: HC $4.00/MF $0.75 CSCL 06B

The design and development of a constraint platform with an attached biotelemetry module is described. The instrumentation records the cardiac-originated inertial accelerations of a subject freely floating in the weightless environment realized in a jet aircraft flying a Keplerian trajectory. The physiological measurements are transduced, signal conditioned, and telemetered by the instrumentation. The airborne receiving station used to receive, display, and store the telemetered data is also described. Linear and angular acceleration measurements were performed with the equipment, and the results represent the first recording of a triaxial inertial acceleration ballistocardiogram. Triaxial electrocardiographic data were simultaneously measured and telemetered to permit correlation of the mechanical and electrical events of the cardiac complex. BCG and ECG flight data recordings; photographs of the equipment; and schematic drawings of the equipment circuitry are included. L.S.

N66-16394*# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.

[FUNCTIONAL EXTENSION OF THE HUMAN HANDS] Progress Report, 1 Apr.–30 Sep. 1965

Thomas B. Sheridan and William R. Ferrell 28 Jan. 1966 12 p refs

(Grant NsG-107)

(NASA-CR-69856; SA-9991-4) CFSTI: HC $1.00/MF $0.50 CSCL 05H

Progress in the following studies is reported: (1) Development of a spatially continuous remote touch sensor through reflection of geometric light patterns from the backside of the hand's skin; (2) Force feed back capability of remote manipulators for long transmission distances; (3) Development of a computer program as manipulative task simulator to measure human operator's performance; (4) Modification of a master-slave manipulator to include elementary touch sensors on its manipulating surfaces; and (6) Program developments for optimal control of dynamic processes over a previewed span of input. G.G.

N66-16429* National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.

SOME CHARACTERISTICS OF MAN PERTINENT TO SPACECRAFT DESIGN AND OPERATIONS

Julien M. Christensen and Conrad L. Kraft *In its* Space Res.: Direc. for the Future, Pt. 3 Feb. 1966 p 214–282 refs (See N66-16426 07-30) CFSTI: HC $6.00/MF $1.75

Presented are considerations of the desirability of including man in certain types of space missions and the nature of human engineering design data. Human performance efficiency, human problems in the space environment, extravehicular space operations, lunar and planetary operations, and the selection and training of personnel are discussed. Some of man's potential includes: (1) contribution to systems reliability by serving as a source of redundancy or backup for electromechanical systems and his ability to diagnose and repair other subsystems; (2) ability to handle unexpected or low-probability events and to evaluate and discard incorrect or inadequate hypotheses; (3) ability to interpret complex materials and events; (4) ability to do things that equipment cannot yet do at all or cannot do with sufficient reliability. E.E.B.

N66-16503# Naval School of Aviation Medicine, Pensacola, Fla.

THE USE OF SEPARATE PREDICTION FORMULAE BASED ON THE PROCUREMENT SOURCE OF OFFICER FLIGHT STUDENTS Special Report No. 65-6

Charles W. Hutchins, Jr. Aug. 1965 11 p refs

(AD-623826) CFSTI: HC $1.00/MF $0.50

Separate multiple prediction formulae were computed on each of the six major procurement source subgroups of the entering officer flight students. This procedure for developing prediction formulae was compared with two other conditions: a pseudovariable condition, which treats each procurement source as a separate dichotomous variable, and the current condition which treats the entire officer group as a whole without taking procurement source into account. Two criteria were used for this comparison, namely, the cross-validation coefficients of each condition, and the discriminatory power of the respective conditions as measured by the

percentage of attritions placed in the lowest 10 percent of the respective predictor scores. The separate formula condition was the most valid upon crossvalidation and was also found to have the best discrimination at the low end of the range; however, its superiority in the former case failed to reach statistical significance. Author (TAB)

N66-16508 Kansas State Univ., Manhattan. Dept. of Psychology.

VISION IN THE GANZFELD

Lloyd L. Avant *In its* Evaluation of Perceptual Frames of Reference Nov. 1965 23 p refs Submitted for Publication (See N66-16506 07-04) CFSTI: HC $4.00/MF $1.00
(TR-34)

A summary of the evidence on exposure to structureless visual fields is presented. The data show the experience of such fields to be characterized by reports of immersion in a sea of light which separates into figure and ground as brightness is increased, chromatic adaptation in colored fields, loss of efficiency in detecting the presence and movement of inhomogeneities introduced into the field, disorientation of the observer, an increased and fluctuating state of accommodation, and the occasional joint occurrence of an apparent cessation of function of the visual mechanism and increased alpha activity in the brain. Author

N66-16510 Kansas State Univ., Manhattan. Dept. of Psychology.

CHANGES IN RESPONSE LATENCY FOLLOWING SHIFTS IN THE PITCH OF A SIGNAL

William Bevan, Russell A. Bell, and Curtis Taylor *In its* Evaluation of Perceptual Frames of Reference Nov. 1965 17 p refs Submitted for Publication (See N66-16506 07-04) CFSTI: HC $4.00/MF $1.00
(TR-36)

Relationships between response latency in a simple vigilance task and the temporal pattern of stimuli presented for detection were examined. These experiments were repeated, with a change in a substantiative property of the focal stimulus substituted for change in the temporal pattern presentation. In the first test, the prediction to be verified was that the difference between the mean latency and the latency of the test (ΔRL) would increase, within limits, as the test tone pitch deviated from the subject's adaptation-level (AL) identified as the pitch of the series tones. This appeared to be confirmed for a range of 300 mels above the series AL. In the second study, the constant pitch adaptation series was replaced by a variable pitch. The prediction was the same, with the subject's AL identified as the average in mels of the series pitches. Results show that the range of differences in ΔRL exceeded those of Experiment 1. The final experiment was conducted to identify the nature of the internal standard against which responses were referenced. Results show that the prediction of the mean as the best estimate of the subjective standard is not unequivocally confirmed. M.G.J.

N66-16526# Army Research Office, Washington, D. C.

TENTH ANNUAL ARMY HUMAN FACTORS RESEARCH AND DEVELOPMENT CONFERENCE

Walter E. Lotz, Jr. Oct. 1964 490 p refs Conf. held at the Army Aviation Center, Fort Rucker, Ala., 5-8 Oct. 1964
(AD-456363)

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N66-16527 Army Personnel Research Office, Washington, D. C.

INFORMATION EXTRACTION AND ASSIMILATION FROM COMMAND SYSTEM DISPLAYS

Charles H. Hammer *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 63–71 refs (See N66-16526 07-05)

Effects of conspicuity coding on time required and errors made in locating updated information was investigated by testing two groups of enlisted men who had made high scores on the Army Classification Battery and the General Technical Test. One group was presented charts of alpha-numeric information on individual display devices, the other used a large group display device; and data for each sample was analyzed separately. Another sample of high level enlisted men was tested on both devices. While individual and group display devices did not affect performance time differently when coded updates were used, subjects reported losing their places when using the group display devices; findings show that individual displays may be used far more efficiently when uncoded updated information is presented. Errors are found to be substantially reduced by coding updated information; and there is a preponderence of errors of omission over errors of commission. Another experiment, dealing with updated symbolic information, showed more errors of omission; as the number of elements increased from 12 to 24, there was not significant performance decrement; with an increase from 2 to 6 elements, however, accuracy decreased from 97 to 69%. M.W.R.

N66-16528 Army Personnel Research Office, Washington, D. C.

THE VALUE OF A NEW REFERENCE TECHNIQUE FOR IMAGE INTERPRETATION

Harold Martinek *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1965 p 72–87 (See N66-16526 07-05)

Two new types of keys were tested in relation to image interpretation. The "rights" key with photographs plus short paragraphs giving hints or clues, was very similar both in quality and terrain to the performance measure which followed. The "error" key, which also portrayed information highly similar to that tested by actual performance, contained annotated photographs of six different common types of errors made in image interpretation. There were three matched groups of subjects; one worked with each key, the third was used as a control. It was found that the "rights" key produced no significant effect on any of the performance variables; right score, wrong score, accuracy score, average confidence score, and the average confidence of right minus wrong responses. The "error" key, however, produced a statistically significant and practical decrease in error as well as an increase in accuracy of image interpreter performance. Appendices give the verbal instructions for both the keys used and the performance measures. M.W.R.

N66-16529 Applied Psychological Services, Wayne, Pa.

EXPERIMENTS IN ELECTROCUTANEOUS INFORMATION TRANSFER

Arthur I. Siegel *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 88–98 refs (See N66-16526 07-05)

Information transfer studies indicate that electrocutaneous signals show merit for warning and alerting signal applications, particularly with the use of an auditory signal. When reactions to auditory, visual, and electrocutaneous signals were studied, it was found that the detected first signal results supported response latency data. Combinations of signals were superior, and visual signal was the poorest of the uni-modal stimuli. Suprathreshold determination experiments indicate the least missed signal, the auditory-electrocutaneous, was detected 98% of the time, whereas 59% of the visual signals were missed on first presentation. When task sharing and collateral task adequacy was investigated, it was found that no electrocutaneous and 81 visual signals were missed; tracking performance was impaired under visual stimulation, but not under electrocutaneous. When the subjective affective tone of electrocutaneous stimuli was considered through an adjectival checklist, sensations such as "moderately mild," "regular," "ticklish," and "tingling" were described. Words like "boring," "painful," and "moving" were among the least used. M.W.R.

N66-16530 Human Sciences Research, Inc., Mc Lean, Va.

EFFECTS OF TARGET/GROUND PARAMETERS ON TARGET IDENTIFICATION

John A. Whittenburg *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 101–109 refs (See N66-16526 07-05)

In order to develop a field criterion test to assess scanning and target identification skills, the effects of the following target/ground parameters on target identification were studied: square mil size over time, contrast, background, clutter, target number, time between targets, atmosphere brightness, angle of view, and percent of time in shadow. Thirty-six combat arm officers were told to report all aggressor equipment and personnel in an assigned observation area. No maps were carried during flight, but following flight, the observers were first asked to fill out standard debriefing forms and then to locate the targets on a large-scale photograph with flight path and checkpoints superimposed. An estimate of 86% of the target-target variability was obtained for 25 target items for which precise square-mil-size-over-time measures were obtained; variability was 56% for the more gross measure of square-mil-size-exposure-time for the entire set of target items. No significant correlations were obtained between observer scores and clutter index, either target time or time between targets, atmospheric brightness, angle of view, or percent in shadow. M.W.R.

N66-16531 Research Analysis Corp., Mc Lean, Va.
CONDUCTING HELICOPTER RECONNAISSANCE EXPERIMENTS WITH AIR CAVALRY ELEMENTS
Harrison N. Hopps, Barry M. Kibel, and Arthur R. Voods *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 110–118 (See N66-16526 07-05)

In a winter environment, a low-dismount tactic for helicopter reconnaissance is found to be superior to the tactics of flying high or nap-of-the-earth with pop-up. This conclusion is based on the percent of ground targets acquiring a helicopter, the total number of times detection was made, and the net number of acquisition advantages scored against helicopters. It was found, however, that helicopters used by air cavalry units acquired about 60% of the available ground targets regardless of the technique employed. Overall effectiveness of a platoon of M114Al scout vehicles is similar to that of a single helicopter employing the nap-of-the-earth with dismount tactic. The ground scout platoon was more effective on the stationary runs and helicopter dismount on moving runs. Performance of both helicopters and ground scouts was significantly better against fluid vehicles with a moving mission than against stationary target complexes. M.W.R.

N66-16532 Technical Operations Research, Fort Benning, Ga.
TREE TOP ALTITUDE NAVIGATION ON RECONNAISSANCE MISSIONS—A REPORT OF TESTS
Earl W. Martin *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 119–132 ref (See N66-16526 07-05)

The role of aircraft type, mission profile and range, ambient illumination, weather, and crew experience upon tree-top altitude navigation for reconnaissance missions is investigated. Nap-of-the-earth flight techniques were used for the specially designed test which was made at different mission ranges during day and night. Aircraft used were low OH-13, UH-1, and OV-1; and it was found that UH-1 crews with modest levels of combined crew experience obtained the top three ranks in accuracy scores and required the least amount of time for briefing and planning activities. No apparent difference was found between fixed and rotary wing crews in terms of navigation during daylight. While nap-of-the-earth navigation at night reduced performance, there was no relation to type of aircraft. Rain and scattering ground fog had the most effect. Further, there was little difference evidenced between performance on short and longer missions. M.W.R.

N66-16533 Army Aviation Human Research Unit, Fort Rucker, Ala.
AVIATOR PERFORMANCE IN THE LIGHT WEAPONS HELICOPTER DURING NAP-OF-THE-EARTH FLIGHT
Francis H. Thomas *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 133–141 refs (See N66-16526 07-05)

In order to assess aviator performance in a light weapons helicopter during nap-of-the-earth flight, a proficiency test was developed which required the integration of flight skills with acquisition and engagement of appropriate targets during a simulated combat mission. Twenty randomly-selected warrant officiers, recent graduates of a rotary wing aviator course, were subjected to a ten-step test. Data obtained indicate considerable variability in aviator performance; and variability on the approach sement is considered to reflect both the aviator's skill and his choice of best flight path as well as his decision of when to engage the target. A statistically reliable association is indicated between disorientation and less effective performance on measurements of time for complete run on prime target, approach time, and approach exposure time. Processing of the gun camera film obtained during flight is underway. M.W.R.

N66-16534 Army Natick Labs., Mass. Psychology Labs.
ANTHROPOMETRY OF U.S. ARMY AVIATORS
Robert M. White *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 147–153 refs (See N66-16526 07-05)

Following a general review of antropometric surveys, details are presented for such a survey conducted on 500 Army pilots in 1959. Forty-one body measurements were taken of each man, and results showed that body proportions of Army aviators were greater than those for Air Force flying personnel and Army men. Use of such findings in the design of equipment is considered. M.W.R.

N66-16535 Army Tank-Automotive Command, Center Line, Mich.
HUMAN VIBRATION RESPONSE
F. Pradko *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p. 154–168 refs (See N66-16526 07-05)

An investigation was made to identify and relate whole-body human response to vehicle vibration. In the vertical and roll position, whole body random vibration tolerance is significantly greater than sinusoidal motion tolerance. Less deviation exists between random and sinusoidal pitch motion. Whole body vibration endurance is greatly increased for the vertical and pitch modes when the space orientation factor is removed by closing the eyes. Pitch vibration is found to be more intolerable than roll or vertical vibrations. When vibration input is applied to the head, vibratory tolerance is noticeably affected at all modes. To reduce these adverse effects, it is recommended that the vibration forces be oriented parallel to the head rather than in a normal direction. M.W.R.

N66-16537 Aberdeen Proving Ground, Md. Human Engineering Labs.
HELICOPTER CYCLIC CONTROL GRIPS—A HUMAN ENGINEERING DESIGN STUDY
Bernard M. Corona *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 183–196 refs (See N66-16526 07-05)

Final configuration for a standardized cyclic grip for Army helicopters was determined through a series of full-size mock-up refinements utilizing switch sizes, quick-disconnect plug size, and thumb-reach plots for overall size determination. All switch actuations on the grip are performed by the thumb with the exception of the armament fire trigger, which is actuated by the forefinger. All switch locations for thumb actuations are on the grip centerline or in a shallow arc to the immediate left and down. A quick-disconnect plug permits replacment of the grip in a few minutes as opposed to the eight or ten hours required for present grip replacement. The prototype grip is presently being flight-tested. M.W.R.

N66-16538 Aberdeen Proving Ground, Md. Human Engineering Labs.
TECHNIQUE OF PERFORMING A MISSIONS ANALYSIS ON ARMY FIXED AND ROTARY WING AIRCRAFT

Stephen Moreland *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 197–208 refs (See N66-16526 07-05)

The need for missions analyses is clearly indicated by the fact that presently used displays, controls, and work space are not compatible with the envelopes and flight missions in which the crew must perform. A task analysis format is presented, and the method for conducting the analysis is detailed. Flight crew, base, and aviation support operations are considered. The proposed technique was used for the analysis of a CV-7A Buffalo aircraft, for which two contingency phases were prepared and inserted into the block-flow analysis to cover a single-engine failure both after take off and in forward edge of the battle area. The resulting follow-on analysis of possible mission payloads, single-engine capability, and tactical situation indicated that under certain conditions the aircraft was endangered because some loads could not be jettisoned. M.W.R.

N66-16539 Army Research Inst. of Environmental Medicine, Natick, Mass.

EFFECTS OF PHYSICAL LOCATION OF STIMULI IN THE VISUAL FIELD ON SIMPLE REACTION TIME

John L. Kobrick *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 227–233 refs (See N66-16526 07-05)

Effects of changing location of visual stimuli on intentional reaction time (IRT) were investigated on a sample of 16 adults with normal vision who performed a simple manual response to flashing light stimuli located at 32 different positions in the visual field. For most lower visual hemisphere locations, IRT's were unaffected; significant decrements were observed only when stimulus locations exceeded 30° elevation above the horizontal line of sight for lateral displacements of more than 55° from the fovea. There were no significant IRT decrements at the periphery of the horizontal line of sight. These findings indicate that some flashing indicators can be safely displaced to peripheral locations to enable the prime display space to be occuplied more effectively on devices requiring continuous monitoring. M.W.R.

N66-16540 North American Aviation, Inc., Columbus, Ohio.

PILOT PERFORMANCE IN SIMULATED LOW-ALTITUDE HIGH-SPEED FLIGHT UNDER VARIED TASK LOADING CONDITIONS

Stanley M. Soliday *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 234–245 refs (See N66-16526 07-05)

In order to investigate the effects of task loading on pilot performance during simulated low altitude, high speed, terrain following flight, experienced pilots were tested on flight missions in a simulator that had a total travel of approximately 12 feet and an acceleration capability of ±6G. The simulator had a functional control system and an associated analog computer for obtaining solutions to the equations of motion for a mechanized aircraft. Flights, which lasted one hour, were made under medium heavy turbulence conditions and under varying conditions of airspeed, terrain, and loading. Average altitude maintained during the flights did not vary with any of the experimental conditions, but it was found that pilots consistently flew too high when going up terrain slopes and too low when going down. Deviations from the required clearance altitude were unaffected by navigation or emergency task procedures, but increased with increasing airspeed or steepness of slopes. Reaction times of the pilots did not change with the varying conditions, nor was there any evidence of pilot fatigue. M.W.R.

N66-16541 Army Aviation Human Research Unit, Fort Rucker, Ala.

ARMY LOW ALTITUDE NAVIGATION—SYSTEM CONSIDERATIONS AND PROCEDURAL SOLUTIONS

Robert H. Wright and T. Harrison Gray *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 246–253 refs (See N66-16526 07-05)

Low altitude and nap-of-the-earth navigation is investigated in terms of mission, personnel, and hardware demands; with the conclusion that a change in both hardware and procedures is necessary to obtain proficiency in very low altitude navigation. Procedural solutions recommended, which can be used by presently available Army equipment, are of two types. One, based on the requirements of rapid initiation of tactical missions, involves shifting flight planning procedures to time periods before receipt of actual mission request or while the aircraft is airborne. The other involves the substitution of simple in-flight computations for the currently-used complex ones which produce unacceptably high error rates during low altitude flying. It is recommended that a route network analogous to those on road maps be established and documented. Minimal training could enable pilots to compensate for drift by estimating angle of drift from road maps. The sighting effect that results from being close to treetops could also be used for drift compensation. Priority hardware items are a terrain position and destination indicator as well as an instrument to handle the scheduling inherent in tactical operations and time–distance relationships. M.W.R.

N66-16542 Army Dept., Washington, D. C. Office of Personnel Operations.

PERSONAL ASPECTS OF THE ARMY AVIATION PROGRAM

Samuel P. Kalagian *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 264–276 refs (See N66-16526 07-05)

Operational aspects, the basic Army aviation career program, and related problems are discussed. Army aviator strengths are listed for the years from 1951 through 1964; and projected estimates are given through 1968. M.W.R.

N66-16543 Army Personnel Research Office, Washington, D. C.

PREDICTING SUCCESS IN ARMY AVIATION COURSES

A. J. Drucker and Harry Kaplan *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 277–284 ref (See N66-16526 07-05)

The development of a program to select enlisted personnel for fixed and rotary wing aviation pilot training was investigated by testing a population of 2000 enlisted men, 1200 officers, and 1200 ROTC cadets. Particular attention was given to selection for warrant officer candidate preflight and rotary wing training. Test batteries were developed for both interim operational use and as models for future selection programs. Battery subtests include mechanical principles, information, and functions; flight orientation, aviation information, visualization of maneuvers, instrument comprehension, complex movements, and spatial orientation. A self-description, which taps information relating to personality is for use in warrant officer batteries; a biographical information, to determine family background, educational achievements, and hobbies and other interests, is included in the commissioned officer selection program. M.W.R.

N66-16544 Army Aviation Human Research Unit, Fort Rucker, Ala.

FLIGHT TRAINING QUALITY CONTROL

John O. Duffy and Edgar N. Anderson (Army Primary Helicopter School) *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 285–293 refs (See N66-16526 07-05)

The quality control program used in the management and operation of the U.S. Army Primary Helicopter School is outlined. The program, which yields current, objective information about all phases of the training program, provides a basis for the evaluation and adjustment of standards to improve flight training practices. Since the program is in operation from day to day, it can detect and correct difficulties before they become major problems. Changes are made gradually so as to maintain smooth flow in training procedures. Research background leading to the quality control system, and the contents and operational aspects of the program are discussed. Illustrations are included which evaluate class performance, compare record of one pilot with all check pilots, and compare short and long-term school averages on various tasks. M.W.R.

N66-16545 Army Aviation Human Research Unit, Fort Rucker, Ala.

AUTOMATED EDUCATION IN THE TRAINING OF LOW ALTITUDE AERIAL OBSERVERS

Peter B. Dawkins *In* Army Res. Office Tenth Ann. Army Human Factors Res. and Develop. Conf. Oct. 1964 p 294–305 (See N66-16526 07-05)

When learning performance of two groups of noncommissioned officers was compared, it was found that an OBVERSE II programmed instruction course taught the four basic observer skills as effectively as did 18 hours of conventional classroom instruction. On the basis of a preliminary investigation, these skills were identified as visual search, target recognition, geographic orientation, and target location. The simplicity and effectiveness of such a programmed instruction course makes it particularly suited for training under field conditions. M.W.R.

N66-16548*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DETERMINATION OF CRITICAL TRACKING TASKS FOR A HUMAN PILOT

James J. Adams, Joseph K. Kincaid, and Hugh P. Bergeron Washington, NASA, Feb. 1966 23 p refs

(NASA-TN-D-3242) CFSTI: HC $1.00/MF $0.50 CSCL 05H

Experiments have been conducted to determine the maximum amount of control element lag, and the maximum and minimum control sensitivity that can be tolerated in a single-degree-of-freedom, manually controlled compensatory tracking task. A relatively easy to satisfy error criterion was used to establish the tolerable limit. An automatic controlled element parameter adjustment was used to determine rapidly the limiting value of the parameter. An automatic model-matching method was used to determine the transfer function of the human operator in these tests. Calculations of the closed-loop system characteristics using the measured pilot transfer function show that the system is being operated with neutral closed-loop stability in the maximum lag configuration, and that the pilot is greatly restricted in his ability to identify, and adjust to, variations in control sensitivity as controlled element lag is increased. Author

N66-16550*# National Aeronautics and Space Administration. Ames Research Center Moffett Field, Calif.

A SIMULATOR STUDY TO DETERMINE PILOT OPINION OF THE TRIM CHANGES WITH POWER FOR DEFLECTED SLIPSTREAM STOL AIRPLANES

Richard F. Vomaske and Fred J. Drinkwater, III Washington, NASA, Feb. 1966 34 p refs

(NASA-TN-D-3246) CFSTI: HC $2.00/MF $0.50 CSCL 05H

A simulator study was made of the effects on pilot opinion of trim change with power. The landing approach and wave-off of a high performance deflected slipstream aircraft was simulated. A wide range of changes of pitching moments with power was investigated at several levels of static longitudinal stability with increasing power were also studied. The study showed that at the more positive levels of static longitudinal stability the lift produced by power markedly affected the apparent pitching moment due to power. In general, the pilots preferred configurations which exhibited the least trim change with power or those for which the power effects did not aggravate the stall or pitch-up margin. A comparison of the test results with current and proposed stability requirements is made. In addition, the test data are compared with flight data available. Author

N66-16583# Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.

ATC SYSTEM ERROR AND APPRAISAL OF CONTROLLER PROFICIENCY

William F. O'Connor and Richard G. Pearson Jul. 1965 17 p refs

(AM-65-10)

This report presents suggestions for the design of an Air Traffic Control (ATC) incident-reporting system aimed at maximizing the amount of corrective feedback to the ATC system. The approach taken is system-oriented rather than controller-oriented. Included is a discussion of a philosophy of corrective and punitive action relative to controller involvement in an incident. Recommendations and examples of format are included for the design of incident-report forms and incident chronology and of a checklist to be used in periodic appraisal of controller performance. Emphasis is given in format design to use of systems and human function, rather than regulatory and procedural terminology. Implementation and data-analysis technique are also discussed. Author

N66-16603*# Naval School of Aviation Medicine, Pensacola, Fla.

THE VALIDITY OF A BRIEF VESTIBULAR DISORIENTATION TEST IN SCREENING PILOT TRAINEES

Rosalie K. Ambler and Fred E. Guedry, Jr. 18 Oct. 1965 16 p refs *Its* Rept.-122

(NASA Order R-47)

(NASA-CR-70146; NAMI-947) CFSTI: HC $1.00/MF $0.50 CSCL 06N

A Brief Vestibular Disorientation Test (BVDT) has been developed that involves an assessment of reactions produced by head movements in a rotating chair. Inter-rater reliability was demonstrated by an earlier study. The present study investigated the validity of the test for predicting pilot training criteria. THE BVDT was administered to 226 naval aviation trainees during the latter part of their pre-flight training. After the subjects had either completed training or were separated therefrom, the test results were evaluated for their relation to the following criteria: 1) students separated from flight training for all causes vs. completions; 2) tension and/or airsick separations vs. all others; and 3) airsick separations vs. all others. Relationships existed between high sensitivity scores on the BVDT and membership in the various separation groups. The airsick separation group had the highest mean score. Evidence indicates that the BVDT ratings tap a significant portion of the flight criterion variance not reached by the present prediction methods. Author

N66-16639# Naval Training Device Center, Port Washington, N. Y.

BIOPOTENTIAL SIGNALS AS A FUNCTION OF LEARNING TASK DIFFICULTY

John L. Andreassi and John D. Cavallari 19 Aug. 1965 35 p refs

(NAVTRADEVCEN-IH-34; AD-625130) CFSTI: HC $2.00/MF $0.50

The present study is concerned with biopotential responses to a learning situation in which the difficulty of materials was systematically varied. In Experiment I, eight Navy enlisted men learned three lists of nonsense syllables (0%, 53% and 100% association value), while heart rate (HR), palmar skin conductance (PSC), galvanic skin responses (GSRs), and muscle action potentials (MAPs) were monitored continuously. Subjects reported for one-hour sessions on each of three successive days. Resting levels of all biopotential signals were taken at regular intervals in each of the experimental sessions. Experiment II was conducted in the same manner with eight college students as subjects. The results showed that: (1) there were definite and large increases in all of the biopotential signals during learning as compared to the resting conditions, (2) the Navy men had significant increases in both PSC and HR with the easy and moderate lists as compared with the most difficult list, (3) the college students had nonsignificant increases in HR as a function of ease of list. The results for the Navy subjects were interpreted in terms of motivational factors. It was suggested that the discrepancy in results for the two groups may have been due to educational and age factors. Author (TAB)

N66-16640# Dunlap and Associates, Inc., Darien, Conn.

SYSTEMS ANALYSIS OF AAW TRAINING REQUIREMENTS

Gabriel G. Jeantheau, Birger W. Andersen, and Kenneth W. Yarnold Port Washington, N. Y., Naval Training Device Center Nov. 1965 80 p refs

(Contract N61339-1574)

(NAVTRADEVCEN-1574-1; AD-625378) CFSTI: HC $2.00/MF $0.75

The Training Analysis Procedure (TAP) is a technique for identifying areas in system operations which provide greatest payoff in system effectiveness through training. The purpose of the study was to apply the TAP to the Navy's AAW system. This application examined two levels of operator performance in systems as a function of method of training and time-to-train. The relative benefits to system performance of training various task groups via different methods are shown. The results indicate that, for the levels analyzed, combined shipboard training for subsystem groups will achieve the greatest payoff in system effectiveness. Findings are cited concerning needs in existing shipboard simulation utilization and additional shipboard training equipment. Recommendations are made for further research to develop information about operator performance for different AAW system states, for research in optimum team organization, and for research to examine the need for and requirements for generalized radar training. Author (TAB)

N66-16643# Isomet Corp., Palisades Park, N. J.

DESIGN OF A TEST MODEL FOR A SOLID ELECTROLYTE CARBON DIOXIDE REDUCTION SYSTEM Final Report, Mar.–Dec. 1964

Horace W. Chandler Wright-Patterson AFB, Ohio, AMRL, Oct. 1965 40 p ref

(Contract AF 33(657)-1498)

(AMRL-TR-65-153; AD-625482) CFSTI: HC $2.00/MF $0.50

A solid electrolyte carbon dioxide reduction system for use in a weightless condition on a planned suborbital missile flight was designed, fabricated, and tested. The system, which converted carbon dioxide to oxygen and carbon monoxide at a rate of 0.01 pounds per hour of carbon dioxide, weighted 39 pounds including all instrumentation and structural supports, occupied a volume of one cubic foot and consumed about 275 watts under steady state operating conditions. The system successfully passed specified acceleration and vibration tests and was delivered to the sponsoring agency for further use. Author (TAB)

N66-16664# Dunlap and Associates, Inc., Darien, Conn.

CONCEPTS AND PRACTICES IN THE ASSESSMENT OF HUMAN PERFORMANCE IN AIR FORCE SYSTEMS Final Report, Sep. 1964–Apr. 1965

James J. Keenan, Treadway C. Parker, and Henry P. Lenzycki Wright-Patterson AFB, Ohio, AMRL, Sep. 1965 202 p refs

(Contract AF 33(615)-1754)

(SSD-65-172(514)R; AMRL-TR-65-168; AD-625041) CFSTI: HC $6.00/MF $1.25

The report describes the current practices and evaluative aspects of human performance assessment in Air Force Systems. The human performance test programs for thirty-four systems and subsystems representing the major types of systems (aeronautical, electronic, missile, and space) used by the Air Force are reviewed. For these systems, the major functional covered include: (1) Air Force policies, directives, requirements, and constraints concerning the development and assessment of system tests and human performance; (2) the behavioral sciences, approach to, and technology for, assessing human performance; and (3) Air Force practices in assessment of human performance. Throughout, the systems context, within which human performance is conceived and evaluated, is emphasized. Consequently, the techniques within the behavioral sciences for examining human performance conceptually and empirically in the system test environment is a particularly practicable part of the report. The report is supported by many tables and charts, excerpts from test directives pertinent to human performance assessment, and approximately 600 categorized references. Author (TAB)

N66-16669# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.

BIOMEDICAL SURVEY OF ATC FACILITIES. 2: EXPERIENCE AND AGE

George T. Hauty, David K. Trites, and William J. Berkeley Mar. 1965 41 p ref

(AM-65-6)

From six enroute and six terminal air traffic control (ATC) facilities selected on the basis of differences between shift-rotation schedules and high IFR traffic volume, 300 journeymen and assistant controllers were selected as volunteer subjects to complete a biomedical inventory daily for a period of 90 consecutive days. The investory elicited information relating to health, morale, behavioral habits, and side effects of medications. Of the 300 subjects, 209 fulfilled the reporting requirements of the 90 days. For one of the indexes of information—stress-related symptoms—analyses of the data revealed that: (1) both length of experience in the air traffic control field and chronological age were related positively to the incidence of such symptoms; i.e., the greater the number of years of ATC experience and the greater the age of the subject, the higher the incidence of symptoms reported; and (2) of these two relationships, the higher and, therfore, the more significant relationship was that involving years of ATC experience. Author

N66-16743# Little (Arthur D.), Inc., Cambridge, Mass.
STUDY AND DEVELOPMENT OF MATERIALS AND TECHNIQUES FOR PASSIVE THERMAL CONTROL OF FLEXIBLE EXTRAVEHICULAR SPACE GARMENTS
David L. Richardson Wright-Patterson AFB, Ohio, AFMRL, Sep. 1965 101 p refs
(Contract A33(615)-1904)
(AMRL-TR-65-156; AD-624886) CFSTI: HC $3.00/MF $0.75

The program encompassed an analytical and experimental investigation of the application of passive thermal control techniques to extravehicular flexible space garmets in 300 nautical mile earth orbits. Results indicate that passive thermal control by varying the absorptance and emittance of the outer surface of the garment is not possible when internal heat generated is in excess of 1500 Btu/hr. For all conditions, the suit's solar absorptance should be as small as possible and its emittance as large as possible. By controlling the conductance of the space suit wall, internal heating rates to 2000 Btu/hr are achievable when the space suit has an absorptance of 0.17 and an emittance of 0.85. A solar parasol with selected radiating properties on each side allows for higher internal heating rates. Experiments were made in a simulated noon orbit with a cylindrical section of a space suit which was first tested with an evacuated insulation and then with a helium-fillable insulation. The range of average conductance for these insulations was 0.3 to 4.0 Btu/sq ft hr F. A range of internal heat generation from 600 to 2100 Btu/hr was achieved when the evacuated insulation was filled with helium. Author (TAB)

N66-16942*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE SUIT DEVELOPMENT STATUS
Richard S. Johnston, James V. Correale, and Matthew I. Radnofsky Washington, NASA, Feb. 1966 31 p
(NASA-TN-D-3291) CFSTI: HC $1.00/MF $0.50 CSCL 06K

Space suit development, starting with the Mercury program, has progressed to its present status as a result of the changing goals of each manned spacecraft mission. The first space suits were designed primarily for protection of flight crews against the possibility of cabin pressure failure. Longer flights and extravehicular activities required design philosophies to change drastically, particularly in the areas of comfort, mobility, reliability, and life-sustaining systems. Future mission goals will require new design objectives and requirements. Author

N66-16946# RAND Corp., Santa Monica, Calif.
CYBERNETICS
M. E. Maron May 1965 8 p refs Submitted for Publication
(P-3144; AD-615710) CFSTI: HC $1.00/MF $0.50

A general review is presented of the historical background and applications of cybernetics. It is pointed out that there are still conflicting attitudes toward cybernetics and about the content of its subject matter. Since cybernetics does offer certain organizational principles which can be described and implemented, it presents both a language and set of concepts to use in obtaining an epistemological theory relating information processing to the activities of learning, thinking, knowing, and understanding. M.W.R.

N66-16954# Joint Publications Research Service, Washington, D. C.
THE CONNECTION BETWEEN MOTOR THEORY AND THE GENERAL PROBLEM OF SPEECH DISCRIMINATION
V. I. Galunov and L. A. Chistovich 11 Feb. 1966 22 p refs Transl. into ENGLISH from Akust. Zh. (Moscow), v. 11, no. 4, Oct.–Dec. 1965 p 417–426
(JPRS-34106; TT-66-30548) CFSTI: $1.00

A general model of speech discrimination is investigated, from which the motor theory of perception is reformulated. A proximity concept, which deals with similarity among elements, is considered; along with the motor theory and its experimental confirmation. Objections to the motor theory are cited, and investigation of experimental tasks relating to speech perception is considered. M.W.R.

N66-16986# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
PROPOSED COMPUTATIONS IN THE CEREBRAL CORTEX BASED ON FOURIER TRANSFORM AND SPATIAL FILTERING TECHNIQUES
George Donald Passmore (M.S. Thesis) Aug. 1965 101 p refs
(GE/EE/65-18; AD-624477) CFSTI: HC $4.00/MF $0.75

The paper employs some recent findings in the field of optics to postulate the nature of the cortical calculation. To show this, a mathematical formulation of an optical transform is discussed. A laser is used to experimentally obtain this transform. The properties of the transform are then investigated. The optical theory is compared with a specified cortical connectivity to model a basic computational cell. An array of these cells are shown to duplicate a transform process similar to the optical transform process. The calculation performed by the array is then simulated on the IBM 7094 computer for various input patterns. Author (TAB)

N66-16990# Naval Submarine Medical Center, Groton, Conn.
STUDIES OF CILIARY MUCUS TRANSPORT IN A CLOSED CABIN ATMOSPHERE
Robert E. Sonnenburg 2 Dec. 1964 17 p refs *Its* Vol. 23, No. 25
(Rept.-443; AD-624754) CFSTI: HC $1.00/MF $0.50

In an attempt to determine what effect, if any, a sealed cabin atmosphere might have on living tissue, observations of frog tissue were made during a routine patrol of a Fleet Ballistic Missile (FBM) submarine. Ciliary mucus flow rates were determined in the esophageal tissue of frogs, since results with these tissues have proved comparable to mammalian respiratory cilia. Bottles of surface air were taken aboard the submarine to permit comparison of tissues exposed to this normal air with those exposed to the ambient air of the submarine. Results showed a definite decrement in ciliary activity in those tissues exposed to submarine air. In addition, sprouted seeds of vegetables and flowers were taken aboard. Despite all efforts to maintain their nutrition and light exposure, they ceased to grow and after 3 weeks had turned brown and died. Ion activity which might account for these results is discussed and further investigation is recommended. Author (TAB)

N66-16997# Army Medical Lab. (5th), St. Louis, Mo.
SAMPLING PROGRAM FOR AIRBORNE RADIOACTIVITY
Donald R. Bowie 31 Jan. 1965 30 p refs
(RB-65-1; AD-624516) CFSTI: HC $2.00/MF $0.50

The basic program involves the collection of particulate matter from a known volume of air. The collector is a high volume sampler equipped with a glass fiber filter. The gross beta radiation emitted by a known fraction of the sample is measured in an appropriate instrument, and the concentration is calculated for the sampling period. TAB

N66-17079*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aerospace Medical Inst.
THE VALIDITY OF A BRIEF VESTIBULAR DISORIENTATION TEST IN SCREENING PILOT TRAINEES
Rosalie K. Ambler and Fred E. Guedry, Jr. 18 Oct. 1965 16 p refs
(NASA Order R-47)
(NASA-CR-70306; NAMI-947) CFSTI: HC $1.00/MF $0.50 CSCL 06N

A Brief Vestibular Disorientation Test (BVDT) has been developed that involves an assessment of reactions produced by head movements in a rotating chair. Inter-rater reliability was demonstrated by an earlier study. The present study investigated the validity of the test for predicting pilot training criteria. The BVDT was administered to 226 naval aviation trainees during the latter part of their pre-flight training. After the subjects had either completed training or were separated therefrom, the test results were evaluated for their relation to the following criteria: (1) students separated from flight training for all causes vs. completions; (2) tension and/or airsick separations vs. all others; and (3) airsick separations vs. all others. Relationships existed between high sensitivity scores on the BVDT and membership in the various separation groups. The airsick separation group had the highest mean score. Evidence indicates that the BVDT ratings tap a significant portion of the flight criterion variance not reached by the present prediction methods. Author

N66-17082*# Melpar, Inc., Falls Church, Va.
HUMAN PERFORMANCE CONTROL MONITORING SYSTEMS Interim Report No. 2
J. M. Gervinski and R. E. Mirabelli 15 Jan. 1966 27 p ref
(Contract NASw-1085)
(NASA-CR-70340) CFSTI: HC $2.00/MF $0.50 CSCL 05H

Basic features are described for a computer program which was written to simulate the dynamics of a second order servosystem under both automatic and manual control. This was constructed in order to determine if trainable logic can be designed to take over the control function of a servo plant by monitoring of human performance, given that failures and/or changes in plant characteristics have occurred in an automatic control system. The operating mode of the system is determined by an external sense switch on the computer, and external sense switches also control the torque value when in the manual mode. The monitoring of this manual mode results in the training of the adaptive logic. Listings for the computer program are appended. C.T.C.

N66-17221*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPACE VEHICLE WATER RECLAMATION SYSTEMS
Dan C. Popma and Vernon G. Collins [1965] 35 p refs Presented at the AIChE 55th Natl. Meeting on Aerospace Life Support Systems, Houston, Tex., 7–11 Feb. 1965
(NASA-TM-X-56123) CFSTI HC $2.00/MF $0.50 CSCL 06K

The necessity and potential sources for water reclamation are discussed and water reclamation system concepts of multifiltration, compression distillation, air evaporation, electrodialysis, and reverse osmosis are reviewed. The reverse osmosis system, utilizing the electrolysis pretreatment, has the advantages of low weight, size, and power requirements. Also, operation is at ambient temperature; byproducts are nontoxic and utilizable; sterilization is inherent in the system; and no expendables are required. Advantages and disadvantages of the other systems are included. E.E.B.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N66-16190*# Radiation Applications, Inc., Long Island City, N. Y.
FABRICATION AND TEST OF BATTERY SEPARATOR MATERIALS RESISTANT TO THERMAL STERILIZATION Final Report
Thomas J. Wetherell and Paul A. Scardaville Dec. 1965 298 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951015)
(NASA-CR-69884) CFSTI: HC $6.00/MF $1.50 CSCL 07D

Fifty-one materials were fabricated, using polyethylene as the base polymer, by crosslinking and grafting procedures. Each material was tested for its ability to withstand heat sterilization and to function as a battery separator in the silver–zinc alkaline system. Cells, constructed from seven materials which successfully withstood heat sterilization, retained greater than 90% of electrical capacity of control cells during five deep cycles of charge and discharge. Two materials were selected to be produced in 500 $ft.^2$ quantities, which are to be used for further testing. Cells were constructed using samples of the two materials which were sterilized in 40% potassium hydroxide at 145°C for three 36 hour heat cycles. The 40% potassium hydroxide from the sterilization chambers was used as the cell electrolyte. All of the cells retained greater than 96% of the capacity of control cells which were similar except that their components were unsterilized. Author

N66-16203# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Physics.
DISSOCIATION OF ETHYLENE MOLECULE IONS FORMED IN CHARGE EXCHANGE COLLISIONS WITH POSITIVE IONS Scientific Report No. 2
I. Szabo 10 Sep. 1965 28 p refs
(Contract AF 61(052)-762)
(AFCRL-65-823; AD-623870) CFSTI: HC $2.00/MF $0.50

Mass spectra of ethylenes (C_2H_4 and CH_2CD_2) were obtained after charge exchange with slow positive ions. The intensities of the peaks were plotted as a function of the energy absorbed by the molecule during the charge exchange. The structure and dissociation of ethylene are discussed. Three distinct processes for the formation of the acetylene ion are proposed. Integration of the breakdown graph gives a mass spectrum in reasonable agreement with that obtained in electron impact. Author (TAB)

N66-16281*# North American Philips Co., Inc., Briarcliff Manor, N. Y.
STUDY PROGRAM TO OBTAIN THE INFRARED ABSORPTION SPECTRA OF POWDERED ROCKS Technical Report No. 174 (Final)
Dec. 1964 72 p refs
(Contract NASw-964)
(NASA-CR-69826; PL-15-FMIR64-1107) CFSTI: HC $3.00/MF $0.75 CSCL 07D

This document is the final report for a study program to determine the feasibility of using the technique of Frustrated Multiple Internal Reflection (FMIR) Spectroscopy for obtaining the infrared absorption spectra of powdered rocks. The

theory of the FMIR technique is discussed, and the instrumentation of the system used in this study is described. The FMIR infrared absorption spectra of silicate powders (of diameters 0 to 43 μ, 150 μ and 300 μ) were of high spectral quality, and no loss of energy due to light scattering was observed. Experimental results indicate that FMIR Spectroscopy is a feasible method for obtaining high quality infrared absorption spectra of powders and rough solids in their natural state.
Author

N66-16312# Bureau of Mines, Washington, D. C.
THE MATRIX-TYPE MAGNETIC SEPARATOR
Foster Fraas 1966 19 p refs
(BM-RI-6722)

A separator for minerals of low magnetic susceptibility and fine particle size in a water suspension is described. A ring-shaped matrix of ferromagnetic fragments rotating so as to pass successively through magnetic-field and field-free regions provides for the separation. Application is illustrated in the separation of hematite and ilmenite from quartz. Author

N66-16329 Indian Inst. of Science, Bangalore. Dept. of Physics.
ESR STUDY OF ANTIPYRENE COMPLEXES OF IRON GROUP IONS
R. Srinivasan and C. K. Subramanian *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 22–29 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Ions of antipyrene perchlorate and iodide complexes of divalent iron groups were studied by X-band reflection-type electron spin resonance spectrometer. Molar quantities of antipyrene, KI, NH_4ClO_4, and chlorides of transition metals were used to grow single crystals complexes. Crystal resonance spectra of Mn^{++} and Cu^{++} complexes were obtained for various orientations at room temperature and at 90° C and their spin Hamiltonians were determined. It was concluded that divalent metal ions form complexes of the type $M(AP)_6 \cdot (ClO_4)_2$ or $M(AP)_6I_2$ where AP stands for antipyrene and M for Mn^{++}. These complexes grow as isomorphous crystals with the space group $P3^{-1}$. The Cu^{++} complex grows as monoclinic crystal of the space group $P2_1/a^1$. G.G.

N66-16330 Indian Inst. of Science, Bangalore. Dept. of Physics.
ESR STUDY IN COPPER (II) DIETHYLDITHIO CARBAMATE
T. Ramasubra Reddy and R. Srinivasan *In* India. Dept. of Atomic Energy Proc. of The Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 30–40 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Covalently bound Cu^{++} ions in sulphur co-ordination were studied for their electron spin resonance response. Both diluted and undiluted single crystals of copper diethyldithio carbamate were measured by resonance reflection spectrometer at X-band utilizing 100 Kc/s filed modulation. The undiluted salt showed a single line in all directions both in the a-c plane and the plane containing the tetragonal axes, indicating a strong exchange interaction between the two non-equivalent Cu^{++} ions. The lines from the two Cu^{++} ions in a dilute crystal could be resolved together with the hyperfine structure from the copper nuclei. In some orientations even the hfs lines of the two isotopes Cu^{63}, Cu^{65} were clearly resolved. Spin Hamiltonians were fitted to the spectra and are shown. Optical absorption bands of dilute single crystals in the visible region showed a clear peak at $21,980^{-1}$ cm, and some strong absorption below 3700 Å in the ultraviolet region. Results were used to construct a model where the unpaired electron is placed in an antibonding orbit of B_{1g} symmetry. A.A.

N66-16333 Tata Inst. of Fundamental Research, Bombay (India).
ESR OF SODIUM SALT OF P-BENZOSEMIQUINONE ION
M. V. Krishnamurthy and B. Venkataraman *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp. Solid State Phys. [1965] p 62–66 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

The free radical p-benzosemiquinone ion was studied in a polycrystalline powder form by electron spin resonance and nuclear magnetic resonance spectrometry. Observed ESR spectra consisted of a single asymmetric line having a width of about 5 gauss. The ESR spectrum of the polycrystalline sample diluted in hydroquinone showed five equally spaced lines and changed to a broad line of poorly resolved structure at liquid nitrogen temperature; further temperature increases resulted in 5 overlapping broad lines. At still higher temperatures the lines became sharper and more intense and approached the room temperature spectrum. Hyperfine components appeared at the transition temperature of $-50 \pm 10°$ C. The proton magnetic resonance at room temperature consisted of a broad unshifted line with a width of about 14 g and remained unchanged even after repeated recrystallizations of the sample. G.G.

N66-16351 Indian Inst. of Science, Bangalore. Dept. of Physics.
NMR STUDY OF FERROELECTRIC DI-GLYCINE NITRATE
K. R. K. Easwaran *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 181–192 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

A modified wideline spectrometer was used to measure proton magnetic resonances of di-glycine nitrate (DGN) crystals at different temperatures. Crystals were grown from aqueous solutions of the components in stochiometric ratios and had a size of 13 mm × 4 mm. Experimental derivative curves for resonance lines at different temperatures from 300.5° K down to 90° K projected a typical three spin system. Protons not belonging to the NH_3 group made little contributions to the second moment. Theoretical values for the second moment showed good agreement with experimentally observed values at room temperature but differed considerably from values obtained at 90° K. Second moment transitions were found in both, polycristalline samples and single crystals at about 192° K and at about 208° K. The latter temperature coincided with the ferroelectric Curie point of the crystal. G.G.

N66-16352 Tata Inst. of Fundamental Research, Bombay (India).
MAGNETIC RESONANCE IN GLYCINE AND ITS ADDITION COMPOUNDS
S. S. Dharmatti, V. Saraswati, and R. Vidayarghavan *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 193–198 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Proton and deuteron magnetic resonances were studied in partially and in completely deuterated glycine and in some of its addition compounds. Glycine-d_5 was prepared by repeated exchange of normal glycine with heavy water and the addition compounds were crystallized from aqueous solutions in stoichiometric ratios. The proton resonance of glycine showed

a 9.5 gauss wide structure at the center. Two additional compounds $G_2(G{=}NH_2CH_2COOH)\ MnCl_2{\cdot}2H_2O$, and $G_2\ BaCl_2{\cdot}H_2O$ had proton resonances similar in width and shape to that of glycine. Deuteron resonance in glycine-d_5 at room temperature consisted of three pairs of lines with peak-to separation 33 ±2kc/s, 46 ±2 kc/s, and 75 ±2 kc/s; on lowering the temperature a 120 kc/s separation became visible. At the lowest temperature were two coupling constants observed, at 173 and at 200 kc/s, indicating the zwitter ion form $ND_3^+\ CD_2COO^-$. G.G.

N66-16353 Saha Inst. of Nuclear Physics, Calcutta (India).
N^{14} RESONANCE STUDY OF THE EQUILIBRIUM OF THE PYRIDINE AND PYRIDINIUM ION IN WATER
Monisha Bose, Nikhilesh Chatterjee, and Nemai Das *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 199-202 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

The ion exchange reaction between Py and PhH^+ was studied by observing the resonanc of N^{14} to which the proton became attached. The pH dependent shift and line width of different equilibrium mixtures of Py and HCl in water was measured by wide line spectrometer at a frequency corresponding to the average shielding of the nucleus. Frequency shifts were compared to the resonance frequency of the NO_3^- ion in NH_4NO_3 and observed resonance values are presented in a table. G.G.

N66-16355 Tata Inst. of Fundamental Research, Bombay (India).
THE STUDY OF LIFETIMES OF POSITRONIUM IN TEFLON IRRADIATED BY GAMMA RAYS
Girish Chandra, V. G. Kulkarni, R. G. Lagu, A. V. Patankar, and B. V. Thosar *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 210-214 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

The effects of free paramagnetic radicals on the quenching of the triplet state of positronium was studied in Teflon samples irradiated by gamma radiation from a Co^{60} source. Concentration of free radicals as a function of the dose of gamma irradiation was measured by electron spin resonance spectroscopy, and the lifetime of positronium was measured by a bridge type amplitude converter coupled to photomultiplier tubes. Concentration of free radicals as well as the degree of quenching of the triplet state, at first increased with the dose of gamma irradiation up to 4.5 mega rads. At higher doses, however, the concentration of free radicals saturated around a value of 1.9×10^{18} spins/cc, while the degree of quenching reached a maximum and then decreased. Saturation of spins and the reversal in quenching occurred around the same dose value of 4.5 mega rads. G.G.

N66-16360 Indian Inst. of Tech., Kanpur. Dept. of Physics.
HELIX-COIL TRANSITION IN SOME HELICAL MACROMOLECULES
V. D. Gupta and A. K. Gupta (Allahabad Univ.) *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 234-238 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

A transition model for diffusion melting was formed and applied to explain helix-coil transitions in poly-L-lysine and poly-L-glutamic acid. The partially helical macromolecule was considered as a sequence of segments which were either in the randomly coiled region or in the helical regions. Boundary segments and segment partition functions were utilized to form the basic matrix for the problem. The usual statistical thermodynamic approach led to expressions for fractions of hydrogen bonds formed and broken. Enthalpy and entropy changes for the transitions per mole of segments were obtained. Results showed good agreement between theory and experiment for single strand helices. G.G.

N66-16361 Banaras Hindu Univ., Varanasi (India). Dept. of Physics.
MULTIPLE-BEAM INTERFEROMETRIC AND X-RAY DIFFRACTION STUDY OF "BUILT-UP" MOLECULAR FILMS OF SOME LONG-CHAIN ORGANIC COMPOUNDS
V. K. Srivastava and Ajit Ram Verma *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 239-249 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Mono- and multi-molecular films of barium stearate, barium palmite, barium margarate, and barium behenate were studied by multi-beam interferometry and X-ray diffraction for the molecular spreading thickness of their fatty acids on water. The actual metrical thickness of the built-up films was determined by observing the shift in wavelengths during build-up of the film. The thickness of the monomolecular stearate film was 25.7 ± 0.3 Å. X-ray diffraction data established the length of the molecular chain in barium stearate as 25.6 ± 0.5 Å. The excellent agreement between the monomolecular thickness determined interferometrically and its chain length measured by X-ray diffraction showed that molecules in the transferred layers are oriented with their hydrocarbon chains almost at right angles to the silver substrate. The same good agreement extended to the other investigated barium films. G.G.

N66-16366 India. Dept. of Atomic Energy, Bombay.
NEUTRON DIFFRACTION STUDY OF AMMONIUM OXALATE MONOHYDRATE, $(NH_4)_2C_2O_4H_2O$
V. M. Padmanabhan, S. Srikantha, and S. Mehdi Ali *In its* Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 292-296 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Neutron diffraction intensities for 125 (hkO) and 45 (Okl) reflections from cylindrical samples of ammonium oxalate monohydrate were studied by single-crystal reflectometer. Observed intensities were reduced to structural factors and compared with (400) reflections from a standard NaCl crystal. Nuclear density projections were drawn on (001) and (100) planes, based on neutron amplitudes and phases derived from X-ray studies. Nitrogen, carbon, oxygen, and hydrogen structural factors were calculated by using neutron scattering lengths values and isotopic temperature factors. The non-planarity of the oxlate radical was confirmed through the absence of major discrepancies between the co-ordinates of C,O, and N. Water molecules linked the oxalate ions by means of a $O_w - H.....$) hydrogen bond into linear chains parallel to the x-axis; the $O_w - H$ inter-atomic distance was 0.09 Å and the inter-hydrogen distance was 1.59 Å with a $H-O_w-H$ angle of 105.6°. Good agreement was found with values obtained from proton magnetic resonance observations. All dimensional values of the oxlate and NH_4 group are shown in a table; some distortion of the tetrahedral NH_4 group was attributed to the linear $N - H.....O$ bond. G.G.

N66-16401*# Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS Quarterly Progress Report, 1 Jul.-30 Sep. 1965

John O'M. Bockris [1965] 72 p refs *Its* Rept.-61
(Grant NsG-325)
(NASA-CR-69855) CFSTI: HC $3.00/MF $0.75 CSCL 07D

Purification of an electrolyte and its cell increased current output of a platinum porous electrode by one order of magnitude. Work on catalytic activities of simple electrode reactions was extended to include Ni–Pd, Ni–Pt, and Fe–Ni alloys. Data on the H_2/H^+ reaction for a series of Pd–Ni alloys are given and briefly discussed. Measurements of the zero charge V_{pzc} under increased pH were made on Pt electrodes and showed a linear decrease with a slope of $dV_{pzc}/dpH = 2.3 RT/F$ when measured on the normal hydrogen scale. Some previous measurements of benzene adsorption on Pt were reproduced, and initiate studies of adsorption by electrochemical methods were prepared. Equations were derived for the terminal cell potential, differential resistance, efficiency and power of an electrochemical energy converter as a function of current drawn from the cell. Numerical calculations of these relations were carried out under varying parameters and the results are shown graphically. G.G.

N66-16452# Technisch Documentatie en Informatie Centrum Voor de Krijgsmacht, The Hague (Netherlands).
GROUNDWATER POLLUTION AND WASTE WATER PURIFICATION [BIBLIOGRAFIE GRONDWATERVERONTREINIGING EN AFVALWATERZUIVERING] Bibliography
G. De Vries Jun. 1965 88 p In DUTCH, GERMAN, and ENGLISH
(TDCK-42563) CFSTI: HC $4.00/MF $0.75

This bibliography is meant as an introduction to literature on the subject of ground water pollution and waste water purification. It contains: abstracts from articles and reports; a list of Dutch institutions engaged in water purification and the quality of open water and ground water in Holland; and a list of the most important periodicals on this subject.
Author

N66-16467# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry.
BEHAVIOR OF THE CARBON ELECTRODE IN MOLTEN CARBONATES
M. D. Ingram and G. J. Janz Nov. 1965 13 p refs Submitted for Publication
(Contract Nonr-591(10))
(TR-27; AD-623979) CFSTI: HC $1.00/MF $0.50

The reversibility of various carbons as electrodes in the ternary carbonate eutectic have been compared. The rest-potential of electrodeposited carbon (−2.2V versus the Danner-Rey electrode) depends on the presence of occluded oxide. The simulation and use of this carbon in a high temperature fuel cell is discussed. Author (TAB)

N66-16481# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
PROCESSING IN LIMITED GEOMETRY. PART 10: STUDIES ON CONTINUOUS MIXING OF POWDERS
K. R. Poole, R. F. Taylor, and G. P. Wall May 1965 42 p refs (AERE-R-4568)

Mixing of spheroidal metal powders and of ceramic oxides has been studied in a continuous ribbon blender at throughputs up to 24 kg/h, using residence times of between 5 and 50 minutes. The homogeneities obtained in powder mixes free from segregation are as good as those obtained in a previous study using prolonged batch mixing (A.E.R.E. R 4226). If rotor speeds in excess of the critical speed are used, equally good results may be obtained in powder mixes liable to segregation. The use of an impact wheel as a combined pre-mixer and agglomerate mill has also been investigated: a 30% improvement was found in the homogeneity of a urania/thoria mixture, compared with that obtained in the ribbon blender alone. Author

N66-16482# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
STUDIES OF THE EQUILIBRIUM METAL VAPOUR PRESSURES OVER THE ALKALINE-EARTH CARBIDES
R. H. Flowers and E. C. Rauh Aug. 1965 25 p refs
(AERE-R-5011) HMSO: 3s

Due to the difficulties in preparing and handling pure samples of alkaline-earth dicarbides, few investigations of their vaporization behavior have been made. In the present work SrC_2 and BaC_2 have been synthesized in a state of high purity, and using both effusion and mass spectrometric techniques the respective vaporization processes have been studied. Values of the heats of formation of these dicarbides have been derived and compared with previous measurements on CaC_2. Author

N66-16485# Library of Congress, Washington, D. C. Aerospace Technology Div.
STRUCTURE OF ORGANIC CRYSTALS (SURVEYS OF SOVIET SCIENTIFIC AND TECHNICAL LITERATURE) Annotated Bibliography
Victor Seemann 30 Dec. 1965 23 p refs
(ATD-65-104)

An annotated bibliography of research studies on organic crystal structure is presented. The bibliography is based on Soviet open-source materials available at the Aerospace Technology Division and other divisions of the Library of Congress. Entries contain brief annotations indicating the method of investigation, equipment used, and resulting data. Materials investigated include: dinitronaphthalene, quasiaromatic copper complexes, alpha-pinene molecules, polyacrylonitrile, diacidodiethylenediamine compounds, viscose cord fiber, pepsin, liquid crystals, Rochelle salt, polytrifluorochloroethylene, 1-phenylalanine hydrochloride, biferrocenyl structure, polybenzimidazoles, pentaerythritol, dinitroalkanes, diurenes, diguanidines, cellulose nitrates, dicyandiamide, cellulose ethers, polypropylene spherulites, ferrocenedisulfonyl chloride, stearates of Co(II) and Ni(II), and diphenylmercury. Appendices containing indicies of authors and associations are also included. M.R.W.

N66-16496# Vitro Labs., West Orange, N. J.
CHEMICAL SYNTHESIS VIA THE HIGH INTENSITY ARC PROCESS
James O. Gibson and Richard Weidman [1962] 47 p refs Sponsored by Navy and AF

Recent chemical engineering applications of the high-intensity arc for the synthesis of high-purity refractory carbides and metals at temperatures of 2,000 to 7,000° Kelvin are described. Emphasis has been placed on uranium carbide because of the present interest in this material for use as a nuclear fuel. The advantages, disadvantages, and versatility of the process to produce different materials in the vaporization, distillation, and drip melting modes are illustrated with the various products which have been synthesized. Original data is presented on an ultra-high temperature distillation process and on the product quality and compositional control aspects of the process. Author

N66-16512# Naval Research Lab., Washington, D. C.
CATHODIC PRETREATMENT EFFECTS ON THE BEHAVIOR OF A PLATINUM ELECTRODE Interim Report
S. Schuldiner and T. B. Warner 28 Apr. 1965 8 p refs
(NRL-6263; AD-624149) CFSTI: HC $1.00/MF $0.50

Hydrogen formed by cathodic polarization of a bright Pt electrode in CO-saturated 1M H_2SO_4 is shown to remain associated with the electrode for relatively long periods of time. Such hydrogen causes unusual open-circuit potential behavior after anodic pulses and can give characteristic hydrogen retions in anodic charging curves. Bringing the electrode potential to a value where hydrogen is normally thought to be absent does not assure that all the hydrogen is removed. Author (TAB)

N66-16576*# National Aeronautics and Space Administration, Washington, D. C.
LATERAL DIFFUSION ELECTRODES, PART IV
D. Doniat Jan. 1966 37 p refs Transl. into ENGLISH of Thesis "Electrodes à Diffusion Laterale", (Section IV), Paris, 1965
(NASA-TT-F-9852) CFSTI: HC $2.00/MF $0.50 CSCL 07D

The use of lateral diffusion electrodes in fuel cells manufactured by powder metallurgy is discussed, with a detailed description of the diffusion processes within the active carbon coating. The physical principles underlying the mass transport of the reactive gas through the microporous and macroporous structure of the active carbon are explained, to substantiate the statement that smaller electrode surfaces, shorter interelectrode spacing, and light-weight current collector grids are possible, resulting in considerable weight reduction of fuel cells (to about 5 kg per kilowatt). Means for further reduction in weight and cost price are listed, including spiral design of the electrodes, low-density materials for casings and other parts, small amounts of catalyst, use of air as oxidizer, reduction in volume of the electrolyte by greater compactness of the electrodes, etc. Author

N66-16581# Bureau of Mines, Pittsburgh, Pa. Pittsburgh Coal Research Center.
ANALYSIS OF LIGHT OILS FROM FLUIDIZED CARBONIZATION
J. G. Walters and C. Ortuglio 1966 34 p refs
(BM-RI-6709)

Analyses of light oils produced from the fluidized carbonization of coal at 485°, 550°, 600°, and 660°C are presented. Tar vapors from 485°C fluidized carbonization were thermally treated at 600°, 700°, and 800°C, and the analyses of light oils produced by this treatment are also presented. Procedures were developed for analysis of coal carbonization light oil by gas chromatography to permit a more definitive analysis than can be obtained by the conventional distillation procedure. An increase in low-boiling olefins, benzene, and toluene, a decrease in low-boiling paraffins, and little change in the remainder of the aromatics was observed with increased temperature of carbonization. Author

N66-16641# Army Weapons Command, Rock Island, Ill. Research and Engineering Div.
DETERMINATION OF THE ALUMINA CONTENT OF ALUMINUM ALLOYS
Richard B. Miclot Nov. 1965 25 p refs
(RIA-65-2959; AD-625257) CFSTI: HC $1.00/MF $0.50

A method has been investigated for the quantitative determination of aluminum oxide in aluminum alloys. Iodine and chlorine were used as isolating agents for aluminum oxide in an aluminum matrix. A spectrophotometric method of aluminum analysis is presented employing these halogen reagents. Limited test results on aluminum foil and wire indicate that a high iodine concentration in methanol, when chlorine is present, yields consistent results of Al_2O_3 content.
Author (TAB)

N66-16665# Colorado Univ., Boulder. Lab. for Atmospheric and Space Physics.
THE DESIGN AND DEVELOPMENT OF A HIGH RESOLUTION ECHELLE VACUUM SPECTROGRAPH AND ITS APPLICATION TO THE MEASUREMENT OF THE MOLECULAR CONSTANTS OF THE $^1\Sigma^+$ STATE OF NO^+ Scientific Report No. 1, Feb. 1962–Aug. 1965
William Robert Simmons [1965] 157 p refs
(Contract AF-19(628)-4961)
(AFCRL-65-670; AD-625337) CFSTI: HC $1.00/MF $1.00

The performance is evaluated of an echelle spectrograph in the Schumann region of the vacuum ultraviolet. A new vacuum spectrograph (primarily intended for rocket use) was designed and built in which off axis parabolic mirrors are incorporated to insure aberration free images at the optic axis. A comparison of parabolic and spherical mirrors is made and a new method of alignment of parabolic mirrors is given. All theory necessary for the design is derived from Rowland's original treatment of the plane grating. In order to demonstrate the capabilities of the echelle spectrograph, echellegrams of NO, NO^+, and H_2 were made. Its dispersive properties and accuracy of wavelength identification is demonstrated by the identification of 123 rotational lines of the (0, 3) and (0, 4) bands of NO^+, thirty-six of which are new. The molecular constants were determined for the $^1\Sigma^+$ of NO^+. Instrumental resolving power is determined by the instrument slit width. TAB

N66-16677# American Oil Co., Whiting, Ind. Research and Development Dept.
THE FO RADICAL AND PRESSURE REACTIONS OF N_2F_2 Eleventh Quarterly Report, 1 Aug.–1 Nov. 1965
A. Zletz et al Nov. 1965 54 p refs
(Contract DA-31-124-ARO(D)-78; ARPA Order 402)
(M65-265; AD-624928) CFSTI: HC $3.00/MF $0.50

Efforts to generate gaseous OF centered upon flash photolysis of CF_3COOF at low temperature. Two transient phenomena were found: at 77°K violet phosphorescence from the solid and at higher temperature two diffuse absorption bands from the gas. Because the phosphorescence is observed from the solid of several fluorocarbonyl compounds, the phosphor is likely an impurity excited by energy transfer from the host lattice. For electrolytic generation of OF_2 from wet HF, ohmic overvoltage at the nickel anode was determined by both potential decay and superimposed square wave. The ohmic overvoltage at normal electrolysis conditions was surprisingly low (0.25 to 0.40 V at 4.8 V anode). Work continued on the structure of N_2F_2 complexes. Solutions of N_2F_5 in SBF_5, blue when fresh but rapidly fading to yellow, were examined by electron paramagnetic resonance to determine if the color arises from free radicals. An EPR spectrum of the yellow solution could be resolved into two separate spectra. The sixteen-line spectrum is consistent with the SBF_5 (−) radical while the five-line spectrum arises from an N_2 containing radical of as yet unknown composition TAB

N66-16684# Rock Island Arsenal Lab., Ill. Research and Engineering Div.
SYNTHESIS OF AMINOQUINONE POLYMERS

Ronald R. Freeman Aug. 1965 18 p refs
(RIA-65-1904; AD-624891) CFSTI: HC $1.00/MF $0.50

Aminoquinone polymers of low molecular weight were synthesized from aliphatic, aromatic and disiloxane diamines with p-benzoquinones and 1,4 napthoquinones utilizing various polymerization techniques. No polymers could be formed from diamines and anthraquinones. The polymers were non-melting powders that were insoluble in conventional solvents but were generally soluble in formic and acetic acids, sulfuric acid and/or dimethylsulfoxide. The thermal stability of these polymers was only fair as DTA and THA analyses indicated initial decomposition in the 250–325C range. In an oxygen flame, the polymers were reduced to ashes. TAB

N66-16692*# Sperry Rand Research Center, Sudbury, Mass.
DEVELOPMENT OF CHEMICAL ANALYSIS TECHNIQUES FOR ADVANCED MATERIALS RESEARCH PROGRAM Fourth Quarterly Progress Report, Sep. 1–Nov. 30, 1965
Fredric D. Leipziger [1965] 14 p Prepared for JPL
(Contracts NAS7-100; JPL-940992)
(NASA-CR-70052; SRRC-RR-65-111) CFSTI: HC $1.00/MF $0.50 CSCL 07B

Results of a study devoted to a series of impurity analyses on MgO and TaC materials are presented. Samples, both powders and compacts were analyzed mass spectrographically. In the analysis of MgO, emission-spectrographic analyses were performed, for those elements which can be handled by emission techniques, to check on the accuracy of the spectrograph. The emission method involves the use of a series of carefully prepared standards which are of known impurity content. The spectrum of the unknown is compared to these standards and this resulted in reasonable comparisons between mass and emission values. In the case of tantalum carbide, a series of wet and colorimetric chemical methods were used to check on mass spectrographic analyses. The elements, sodium, potassium, calcium, fluorine, and silicon were determined by these methods because emission-spectrographic analyses are somewhat doubtful in these cases. Metallic as well as gaseous impurities were determined. M.R.W.

N66-16725# Minnesota Univ., Minneapolis.
OXIDATIVE STUDIES OF POLYPHENOLS Final Technical Report, 1 Jun. 1961–31 May 1964
John E. Wertz and John W. Thomas 1 Oct. 1965 53 p refs
(Grant DA-ARO(D)-31-124-G112)
(AROD-3153-1; AD-624875) CFSTI: HC $3.00/MF $0.50

The primary purpose was to apply electrolytic techniques to quinone and hydroquinone systems to help elucidate the auto-oxidation process for the latter. Special conditions must be observed to detect free radicals formed by electrolytic oxidation of hydroquinones, but quinones are readily reduced to semiquinones in a number of solvents. Seldom did subsidiary lines appear in the spectra that cannot be attributed to a semiquinone. Evidence is presented that variation of proton splitting constants for semiquinones is due primarily to H bonding in protic solvents. Investigation of the system of diprotonated semiquinone cations in concentrated H_2SO_4 showed that some quinones are apparently reduced to diprotonated semiquinone cations in 96–98% H_2SO_4, i.e. no additional reducing agent is necessary. The reaction of trivalent titanium ion with H_2O_2 was used to generate primary radicals that can be used to abstract H atoms from organic molecules, thereby generating free radicals that would be difficult to produce otherwise. Preliminary observations are made on the free radicals formed from quinones and the Lewis acids aluminum chloride and boron trifluoride. TAB

N66-16726# California Univ., Berkeley.
TRANSPORT PROCESSES IN ELECTRODE SYSTEMS Final Report, Mar. 16, 1962–Mar. 1, 1965
D. N. Bennion, T. W. Chapman, S. L. Gordon, R. G. Hickman, G. L. Horvath et al Mar. 1965 259 p refs
(Contract DA-36-039-SC-89153; ARPA Order 220-61)
(AD-621824) CFSTI: HC $6.00/MF $1.25

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1. CURRENT DISTRIBUTION AT A GAS-ELECTRODE-ELECTROLYTE INTERFACE p 16–66 refs (See N66-16727 07-06)
2. IONIC MASS TRANSPORT BY COMBINED FREE AND FORCED CONVECTION p 67–105 refs (See N66-16728 07-06)
3. THE ROLE OF IONIC MIGRATION IN ELECTROLYTIC MASS TRANSPORT; DIFFUSIVITIES OF $[Fe(CN)_6]^{3-}$ AND $[Fe(CN)_6]^{4-}$ IN KOH AND NaOH SOLUTIONS p 106–131 refs (See N66-16729 07-06)
4. MASS TRANSFER IN CONCENTRATED BINARY ELECTROLYTES p 132–151 refs (See N66-16730 07-06)
5. DIFFUSION COEFFICIENT AND SOLUBILITY OF O_2 IN AQUEOUS KOH SOLUTIONS p 152–175 refs (See N66-16731 07-06)
6. IONIC MASS TRANSPORT AND CURRENT DISTRIBUTION IN CHANNELS AT HIGH VELOCITY FLOW p 176–200 refs (See N66-16732 07-06)
7. TRANSPORT PROPERTIES OF CONCENTRATED ELECTROLYTIC SOLUTIONS p 201–233 refs (See N66-16733 07-06)

N66-16727 California Univ., Berkeley.
CURRENT DISTRIBUTION AT A GAS-ELECTRODE-ELECTROLYTE INTERFACE
In its Transport Processes in Electrode Systems Mar. 1965 p 16–66 refs (See N66-16726 07-06) CFSTI: HC $6.00/MF $1.25

The formation of a thin film of electrolyte above the intrinsic meniscus on clean nickel and silver electrodes was confirmed. The thickness of this film was of the order of magnitude of the wave length of visible light. For cathodic oxygen electrodes, current density distribution measurements established that a large portion of the current arises in the thin electrolytic film above the intrinsic meniscus. Also, the thicker the film and the smaller the applied current, the further the current spreads over the electrode surface covered by the film. At a given value of applied current, the reaction is concentrated nearer the intrinsic meniscus on silver than on nickel. Oxygen transport is not limiting in the thin upper film. The current density distribution in this region arises from a balance between charge transfer overpotential and resistance drop in the film. Below the intrinsic meniscus, the bulk electrolyte region, the oxygen activity decreases rapidly due to the mass transport limitation of dissolved oxygen. The high concentration gradients which result when water is not supplied from the gas phase point to the desirability of supplying water as vapor in the oxygen gas. E.E.B.

N66-16728 California Univ., Berkeley.
IONIC MASS TRANSPORT BY COMBINED FREE AND FORCED CONVECTION
In its Transport Processes in Electrode Systems Mar. 1965 p 67–105 refs (See N66-16726 07-06) CFSTI: HC $6.00/MF $1.25

In the presence of buoyancy forces, average rates of ionic mass transport to horizontal electrodes in channel type cells may be predicted with satisfactory accuracy by the equation

proposed by Fenech and Tobias when the process is controlled by free convection or by the equation proposed by Norris and Streid when superimposed laminar flow is the controlling convectional mode. Laminar flow causes a nonuniform distribution of local transport rates; while the mass transfer coefficient decreases from the leading edge in pure laminar flow, onset of secondary convection causes an increase in local coefficients at a predictable distance downstream. Evidence of secondary convection, probably roll cell motion, is given by stratified deposits obtained in locations where free convection contribution to the transport process is significant. When the bulk flow is turbulent the effect of free convection on mass transport rates appears to be negligible within the ranges of Rayleigh and Schmidt numbers and parameters are considered. E.E.B.

N66-16729 California Univ., Berkeley.
THE ROLE OF IONIC MIGRATION IN ELECTROLYTIC MASS TRANSPORT; DIFFUSIVITIES OF $[Fe(CN)_6]^{3-}$ AND $[Fe(CN)_6]^{4-}$ IN KOH AND NaOH SOLUTIONS
In its Transport Processes in Electrode Systems Mar. 1965 p 106–131 refs (See N66-16726 07-06) CFSTI: HC $6.00/MF $1.25

Mass transfer in an electrolyte can be described by four relationships: a flux equation, continuity equation, and a charge conservation equation which are analogous to non-electrolytic mass transfer systems; and the statement of electroneutrality which is unique to ionic mass transfer. The principal equations are given and the effect of migration is considered. Also, the quantitative calculation of the limiting current for a specific flow system, i.e., for a constant potential gradient is presented. It was concluded that the changing concentrations in the mass transfer boundary layer are important in determining the contribution of ionic migration to the limiting current. For the special case of a constant potential gradient, the limiting current, including migration effects, can be calculated rigorously. The diffusion potential contributes to the electric field which promotes migration. E.E.B.

N66-16730 California Univ., Berkeley.
MASS TRANSFER IN CONCENTRATED BINARY ELECTROLYTES
In its Transport Processes in Electrode Systems Mar. 1965 p 132–151 refs (See N66-16726 07-06) CFSTI: HC $6.00/MF $1.25

Equations are presented for the macroscopic description of ionic mass transport in electrolytic solutions. The relations proposed for the concentration dependence of the diffusion coefficients allow these coefficients to be predicted with sufficient accuracy for solutions where measurements are not available. E.E.B.

N66-16731 California Univ., Berkeley.
DIFFUSION COEFFICIENT AND SOLUBILITY OF O_2 IN AQUEOUS KOH SOLUTIONS
In its Transport Processes in Electrode Systems Mar. 1965 p 152–175 refs (See N66-16726 07-06) CFSTI: HC $6.00/MF $1.25

The diffusion ceofficient of oxygen in aqueous KOH was determined at 25° C. Because of the rapid increase of the oxygen diffusion coefficient with decreasing KOH concentration in dilute solutions, it is difficult to make an accurate extrapolation to determine the value in water. From the data it is estimated to be between 1.9 and 2.0×10^{-5} cm^2/sec at 25° C and between 4.6 to 4.8×10^{-5} cm^2/sec at 60° C. These estimates correspond to a temperature coefficient of 2.4%/deg for the diffusion coefficient in water. The product of the diffusion coefficient and the viscosity was plotted and it was noted that the decrease in viscosity with increasing temperature does not account for the temperature coefficient of the diffusion coefficient. E.E.B.

N66-16732 California Univ., Berkeley.
IONIC MASS TRANSPORT AND CURRENT DISTRIBUTION IN CHANNELS AT HIGH VELOCITY FLOW
In its Transport Processes in Electrode Systems Mar. 1965 p 176–200 refs (See N66-16726 07-06) CFSTI: HC $6.00/MF $1.25

Design and construction of equipment, electrolyte circulation system, electrode flow-cell, power supply, and electric measurement system for the investigation of ionic mass transport and current distribution in channels at high velocity flow are discussed. Also, the influence of free convection is considered for transverse flow patterns, instability, and transitions. After test runs have been completed and the regulation characteristics of the electrolyte circulation system are established, the investigation will be conducted (1) employing the wide electrode-channel and a copper deposition electrode reaction; and (2) employing the narrow electrode channel and a ferriferrocyanide reduction reaction on nickel cathode. E.E.B.

N66-16733 California Univ., Berkeley.
TRANSPORT PROPERTIES OF CONCENTRATED ELECTROLYTIC SOLUTIONS
In its Transport Processes in Electrode Systems Mar. 1965 p 201–233 refs (See N66-16726 07-06) CFSTI: HC $6.00/MF $1.25

The transport properties of concentrated electrolytic solutions were determined over a wide range of conditions. The conductivities of ammonium nitrate solutions of various compositions and at various temperatures are given. It is observed that for this salt the conductivity at any temperature goes through a maximum in the high concentration range which is common for a number of electrolytes including KOH. The conductivity, transference number numbers, and diffusion coefficients of KCl in water at 25° C, the conductivity of $CuSO_4$ in water at 25° C; and the diffusion coefficients of $CuSO_4$ and NH_4NO_3, in water at 25° C are included. E.E.B.

N66-16735# Naval Research Lab., Washington, D. C.
PHOTODEGRADATION OF HIGH POLYMERS IN SOLUTION. PART 2: SOLVENT EFFECTS IN THE PHOTOLYSIS OF POLYSTYRENE Interim Report
T. R. Price and R. B. Fox 21 Oct. 1965 21 p refs (NRL-6328; AD-624593) CFSTI: HC $1.00/MF $0.50

Polystyrene photolysis in solution under ultraviolet irradiation by low-pressure and medium-pressure mercury lamps was studied in the presence and absence of air at about 25C. Both intrinsic viscosity and ultraviolet spectral changes were followed during the exposures. In the absence of air, crosslinking is a major process; a measurable decrease in viscosity occurred only in dioxane and carbon tetrachloride and, at sufficiently high doses, insoluble material was formed. In the presence of air, viscosity decreases were observed in all solvents; apparent quantum yields for random scission ranged from 0.0002 in cyclohexane to 0.11 in carbon tetrachloride. In the latter solvent, quantum yield decreased with increasing polymer concentration and intensity of absorbed radiation. Carbon tetrachloride sensitized the degradation in cyclohexane, and small amounts of cyclohexane acted as an inhibitor in carbon tetrachloride solutions. Spectral changes were similar to those observed earlier for poly(alpha-methylstyrene). Mechanisms are suggested. Author (TAB)

N66-16752# Imperial Coll. of Science and Technology, London (England).
TRANSITION-METAL CARBON CHEMISTRY Technical Report, Nov. 1962–Nov. 1963
G. Wilkinson Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1965 11 p
(Grant AF-EOAR-62-55)
(ML-TDR-64-135; AD-624988) CFSTI: HC $1.00/MF $0.50

The use of hexafluorobut-2-yne for the preparation of inorganic complex compounds was investigated. Compounds were prepared which are complexes of tetrakis (trifluoromethyl) cyclopentadienone and hexakis (trifluoromethyl) benzene. They were studied chemically and also structurally by X-ray diffraction. Author (TAB)

N66-16753# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 277
13 Jan. 1966 54 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 8, Aug. 1965 p 676–688 (JPRS-33736; TT-66-30180) CFSTI: $2.00

CONTENTS:

1. CHEMISTRY OF CARBONION ONIUM SALTS (YLID) Y.-t Huang p 1–22 refs (See N66-16754 07-06)

2. PROGRESS IN CARBENE CHEMISTRY AND SOME PROBLEMS H.-k Chiang p 23–41 refs (See N66-16755 07-06)

3. PARALLEL MICROWAVE SUBSTITUTION METHOD FOR THE MEASUREMENT OF MICROWAVE DEVIATION T.-m. Ch'en p 42–48 refs (See N66-16756 07-23)

N66-16754 Joint Publications Research Service, Washington, D. C.
CHEMISTRY OF CARBONION ONIUM SALTS (YLID)
Yao-Tseng Huang *In its* Transl. on Communist China's Sci. and Technol. No. 277 13 Jan. 1966 p 1–22 refs (See N66-16753 07-06) CFSTI: $2.00

The onium ions of the elements of group V and VI and carbonium ion form salts called ylids. Examples of these salts are $Me_3\overset{+}{N}-\overline{C}H_2$; $Ph_3\overset{+}{P}-\overline{C}H_2$; and $Me_2\overset{+}{S}-\overline{C}H_2$. Nitrogen, phosphorus, arsenic, antimony, and sulfur form such salts; however, the salts of selenium and tellurium have not yet been reported. A description of the development of this branch of chemistry is given and the synthesis and reactions of these kinds of organic compounds are summarized. E.E.B.

N66-16755 Joint Publications Research Service, Washington, D. C.
PROGRESS IN CARBENE CHEMISTRY AND SOME PROBLEMS
Hsi-k'uei Chiang *In its* Transl. on Communist China's Sci. and Technol. No. 277 13 Jan. 1966 p 23–41 refs (See N66-16753 07-06) CFSTI: $2.00

The chemical synthesis and reactions of the intermediate carbenes in a wide variety of chemical complexes and carbene-like compounds are discussed. The differences between free carbene and complex carbene or carbene-like compounds is considered. Also, the relation between ylides or carboniums and the carbenes is included. Progress in the study of inserted reactions, rearrangement reactions, and the transitional compounds or structures observed in carbene chemistry is summarized. E.E.B.

N66-16805# Brown Univ., Providence, R. I. Metcalf Research Lab.
X-RAY STUDIES OF SIMPLE CRYSTALS Final Report, 1 Sep. 1951–30 Nov. 1964
Gene B. Carpenter 15 Nov. 1965 9 p refs
(Contract Nonr-562(04))
(AD-624435) CFSTI: HC $1.00/MF $0.50

An investigation was made of the crystal structures of certain simple hydrogen-bonded systems which are crystalline only below room temperature. The scope of the study widened to include other kinds of weak intermolecular forces as well as hydrogen bonds, and to include a few crystals with melting points above room temperature. TAB

N66-16811# Joint Publications Research Service, Washington, D. C.
ULTRAPURIFICATION DISTILLATION
Chu-Fu Fu *In its* Transl. on Communist China's Sci. and Technol. 17 Jan. 1966 p 113–126 refs (See N66-16806 07-34) CFSTI: $6.00

Fractional distillation methods for ultrapurification of small amounts of expensive materials are discussed. Advantages and calculation methods for refluxed fractional distillations as well as semicontinuous back-feed distillation methods are presented. It was concluded that fractional distillation methods are economical when the impurities consist of more volatile components; less volatile impurity components can best be removed by semicontinuous distillation methods because these processes require less material consumption. G.G.

N66-16923*# General Motors Corp., Indianapolis, Ind.
A SPECTROSCOPIC METHOD OF TEMPERATURE MEASUREMENT WHICH DOES NOT REQUIRE TRANSITION PROBABILITIES
R. T. Schneider, W. N. Woerner, and H. E. Wilhelm Washington, NASA, Feb. 1966 37 p refs
(Contract NASw-922)
(NASA-CR-382) CFSTI: HC $2.00/MF $0.50 CSCL 20I

A spectroscopic method is described which allows temperature or pressure measurement without the requirement of knowing the transition probabilities of the spectrum lines employed. Neither calibration of a photographic plate nor use of a radiation standard is required. The measurement is made by comparing the intensity ratios of two spectrum lines emanating from two different locations in the plasma which have different temperatures. The applicability is restricted to those pressure-temperature regions from the point where appreciable ionization starts up to the point of complete ionization. The theory underlying the method is presented and experimental results of applying the method to a cesium plasma are reported. Author

N66-16929# Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
HAZARDS OF PNEUMATIC TRANSPORT OF SOLID EXPLOSIVES
D. K. Heere, F. T. Kristoff, D. Smith, and R. H. Richardson [1965] 47 p refs Presented at the Armed Serv. Explosives Safety Board, 7th Ann. Explosives Safety Seminar, Cocoa Beach, Fla., 24–26 Aug. 1965
(ABL/Z-84)

This paper presents the results of an investigation of the hazards involved in pneumatically transporting solid explosive materials. Consideration is given to the theory of pneumatic

transport and the effect of flow parameter variations on transport conditions. Experimental data are presented to substantiate the theoretical considerations and to define previously uninvestigated parameter interrelations. The factors considered are particle size and shape, material flow density, transfer line size, acceleration distance and mode of particle flow. An applicable correlation of conditions is presented, and the application of results obtained on an experimental scale to process operations is discussed. The sensitivity and reaction of explosive materials to the forces and energies encountered during pneumatic transport are discussed. Factors of prime importance considered are initiation of material by impingement with transport system components or by inter-particle collision, the transition to explosive reaction through initiation of secondary reaction in dust-laden atmospheres, and the generation of explosive dusts. Test methods for determining impingement sensitivity as a function of particle velocity are presented. The effects of system configuration and materials of fabrication on impingement sensitivity are discussed. Methods of reducing hazards, such as modifying the system design setting operating limits, and using inert atmosphere, are considered. Author

N66-16956# Bureau of Mines, College Park, Md.
SPECTROCHEMICAL ANALYSIS OF TUNGSTEN
Robert C. Gabler, Jr. and M. J. Peterson 1965 49 p refs (BM-EI-6632)

Methods for the direct spectrochemical determination of impurities at the parts-per-million level in tungsten metal and oxide are presented. Several published procedures were investigated and numerous modifications were made in establishing procedures with improved precision and extended lower levels of determinability. Details of standards preparation are presented, experimental work is described, and three preferred methods are described in detail. A germanium carrier-distillation procedure is applicable to the determination of 13 elements in tungsten powder; a silver chloride carrier-distillation procedure provides for the determination of 24 elements in tungstic oxide, and a choice of methods to be used depends upon sample form, elements and concentrations to be determined, and the precision and accuracy required. Author

N66-17041# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHESIS AND PROPERTIES OF ORGANOELEMENTAL POLYMERS WITH SILICON, GERMANIUM, AND TIN IN THE CHAIN
L. K. Luneva, A. M. Sladkov, and V. V. Korshak 1 Dec. 1965 12 p refs Transl. into ENGLISH from Vysokomol. Soedineniya (USSR), v. 7, no. 3, 1965 p 427-431
(FTD-TT-65-1662/1+2+4; AD-624725) CFSTI: HC $1.00/MF $0.50

There were obtained organosilicon, organogermanium, and organotin polymers which contain double bonds in the chain, alternating with the atoms of silicon, germanium, and tin. The data of the electrophysical investigations (internal resistance and energy of activation of conductivity) justify ones assuming that the d-orbits of Si, Ge, and Sn take part in the formation of the chemical bond. Author (TAB)

N66-17123# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.
A PYROLYTIC CELL FOR THE CHROMATOGRAPHIC STUDY OF POLYMERS
P. Drienovský and O. Kysel' Aug. 1965 5 p refs Transl. into ENGLISH from Chem. Zvesti (Bratislava), v. 17, 1963 p 912-915
(T-1-SI; AD-624841) CFSTI: HC $1.00/MF $0.50

A pyrolytic cell is described which may be used in conjunction with gas chromatography in the study of pyrolytic processes and the analysis of polymer substances. Author (TAB)

N66-17168# Chicago Univ., Ill. Dept. of Chemistry
RADIOLYSIS STUDIES OF FLUOROCARBONS AND ON REACTIVE INTERMEDIATES Technical Progress Report, 15 Oct. 1964-31 Jul. 1965
Larry Kevan 13 Aug. 1965 31 p refs
(Contract AT(11-1)-1365)
(COO-1365-7) CFSTI: HC $2.00/MF $0.50

Experimental results are presented on the SO_2 yields and organic products formed by γ-radiolysis of diparatolyl sulfone, diphenyl sulfone, and dibenzthiophene sulfone. A large number of oxyanions was examined for their ability to trap hydrogen atoms in gamma-irradiated frozen solutions at 77° K; effects of added electron scavenger and optical bleaching were also studied. Evidence was found for the following hydrogen atoms precursors: H_2PO_4, HSO_4, and ClO_4. Energy transfer in the γ-radiolysis of rare gas-C_2F_6 mixtures was studied, and a recombination energy-transfer efficiency correlation was found. NSA

N66-17178# Battelle-Northwest, Richland, Wash. Chemistry Dept.
FREE RADICALS FORMED BY γ IRRADIATION OF ORGANIC SOLUTES IN WATER
D. R. Kalkwarf and R. N. Diebel 18 May 1965 15 p refs Presented at the Am. Chem. Soc. Northwest Regional Conf., Richland, Wash., 14 Jun. 1965
(Contract AT(45-1)-1830)
(BNWL-SA-199; CONF-650628-1) CFSTI: HC $1.00/MF $0.50

Electron spin resonance (ESR) spectrometry and a flow system including a Gammacell facility, were used to study free radicals within a short time (3 to 5 sec) after their formation in dilute aqueous solutions of organic compounds. For sodium *p*-nitrobenzoate in deoxygenated water, the ESR spectrum indicates that hydrated electrons react with the anions to form $p\text{-}NO_2C_6H_4CO_2^{=}$ radicals, while the hydroxyl radical reaction is too slow. Addition of EtOH increases the radical concentration. The decay of signal amplitude was found to be slow and indicated only one radical species but with two decay rates. Similar results were obtained for *p*-nitroaniline and flavin mononucleotide in deoxygenated water, with hydrated electrons reacting to form long-lived radicals. Aqueous solutions of benzene and sodium benzene sulfonate, however, gave no ESR signal upon irradiation. NSA

N66-17182# Atomic Power Development Associates, Inc., Detroit, Mich. Liquid Metal Cooled Reactors Branch.
THE DETERMINATION OF OXYGEN IN SODIUM METAL
D. F. Boltz, J. O. Kermoshchuk, and S. A. Meacham 2 Jul. 1965 34 p refs
(Contract AT(11-1)-865)
(APDA-168) CFSTI: HC $2.00/MF $0.50

A method for the determination of oxygen in sodium metal was modified and refined to increase the sensitivity and reliability. Sodium metal is separated from the insoluble residues, which should include all chemical compounds containing oxygen, by amalgamation and extraction with mercury

The oxygen-bearing residue is dissolved in deionized water, titrated with sulfuric acid in the presence of excess sodium hydroxide using a modified methyl red indicator, and the oxygen concentration is calculated from the total alkalinity. The combining weight of oxygen in sodium monoxide is 8, in sodium hydroxide it is 16, and in sodium carbonate it is 24 if all the combined oxygen is considered. However, it is conventional to report oxygen concentrations in sodium calculated on the basis that all of the alkalinity in the insoluble residue is due to sodium monoxide. The effect of the presence of sodium carbonate and sodium hydroxide on the validity of the analytical results is also reported. The recommended procedure, based on the principles of tae Pepkowitz and Judd method, is applicable to the determination of 10 to 100 ppM of oxygen in metallic sodium with a relative standard deviation of approximately 10 per cent. Author (NSA)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N66-16201*# Stanford Research Inst., Menlo Park, Calif.
TECHNICAL PROBLEMS ASSOCIATED WITH COMMUNICATION SATELLITES Supplemental Report, 1 Oct. 1963–30 Apr. 1964
R. G. Gould and W. R. Vincent 18 Jan. 1966 12 p
(Contract NASr-49(08))
(NASA-CR-69897) CFSTI: HC $1.00/MF $0.50 CSCL 17B

The question whether customers would reject circuits with delays of 600 msec is discussed and it is concluded that circuits with these delays have a high enough probability of being acceptable in commercial service to warrant providing them to the general public. Experience with these circuits over the next few years will aid in a choice of ultimate communication satellite system designs. Also, the question of whether or not it is necessary in an international telephone connection to limit the propagation time between two subscribers is discussed. Recent tests have shown that international connections probably would not cause adverse subscriber reaction due to the combined effect of delay and echo suppressors if the mean one-way propagation time is increased from near zero to the order of 150 ms. As the propagation time is increased beyond 150 ms, subscriber difficulties increase, and the rate of increase of difficulty rises, up to and including the maximum one-way propagation time tested, namely 400 ms. E.E.B.

N66-16202# Motorola, Inc., Chicago, Ill. Chicago Military Electronics Center.
SPECTRUM SIGNATURE MEASUREMENTS FOR RADIO SET AN/TRC-87 Final Report
Carl P. Jesperson Griffiss AFB, N. Y., RADC, Oct. 1965 215 p
(Contract AF 19(628)-529)
(RADC-TR-65-244; AD-623761) CFSTI: HC $6.00/MF $1.25

The report describes results of spectrum signature measurements on Radio Set AN/TRC-87, a UHF communications system at the Chicago Military Electronics Center of Motorola, Inc. Measurements were taken in accordance with MIL-STD-449A and approved procedures for the AN/TRC-87 system. ECAC bulletins were used as a guide to improve the reliability of the results. TAB

N66-16226*# Chrysler Corp., Huntsville, Ala.
SATURN ANTENNA SYSTEMS SA-5, VOLUME 1
Thomas B. Hickman 18 Jun. 1963 466 p Suppl. to "Checkout Procedures for SA-5 RF Systems Publications"
(Contract NAS8-4016)
(NASA-CR-69711) CFSTI: HC $7.66/MF $2.25 CSCL 09F

Antenna radiation pattern contour plots, and polar and rectangular plots are given for the Saturn I /SA-5/ launch vehicle vhf telemetry antenna system and Minitrack-VOT antenna system. The vhf system consists of six two-element array antennas, divided into three sets of two each. One set is located on the instrument unit; the other two, on the booster. Each of the three sets has its own transmitter and multiplexer configuration. The Minitrack-VOT system consists of two shunt fed stub antennas located on the payload. They are coupled together by a hybrid ring to a Minitrack and a VOT transmitter. The presence of two transmitters gives rise to two different radiation patterns. Also included for both systems are the specifications, explanations of radiation patterns, trajectory geometry, descriptions of pattern and polarization symbols and gain determination, and checkout procedures. D.T.

N66-16259# Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF RADIO WAVE REFRACTION IN THE LOWER LAYERS OF THE ATMOSPHERE AT LOW ANGLES OF ELEVATION
A. I. Sazonov 20 Jan. 1966 11 p refs Transl. into ENGLISH from Uch. Zap. Tomsk. Gos. Univ. (Tomsk), v. 36, 1960 p 79–81
(JPRS-33812; TT-65-30255) CFSTI: $1.00

Changes in the refractive index of atmospheric radio waves were compared with computational results on the refraction integral for 15 specific M profiles as approximated by means of two or more linear layers. For small angles of elevation the value and sign of the refraction angle depended on the vertical distribution of the refractive index; satisfactory agreement between experimental values and computations based on geometrical concepts was obtained for a 19.2 km long path when the heights of the target and receiving antenna were low. G.G.

N66-16264# Harvard Univ., Cambridge, Mass. Cruft Lab.
COUPLED DIPOLES IN A DISSIPATIVE MEDIUM. PART I: THEORY. PART II: MEASUREMENTS
R. W. P. King, S. S. Sandler, and Keigo Iizuka 20 Jul. 1965 36 p refs
(Contract Nonr-1866(32); Grant NSF GP-851)
(TR-479; AD-623779) CFSTI: HC $2.00/MF $0.50

The admittance and impedance of a two-element array when immersed in an arbitrary dissipative medium are determined from a generalization of the King-Sandler theory of arrays. Numerical results are given for half-wave and quarter-wave dipoles with two different thicknesses. The distance between the element is the independent variable. Experiments carried out in a tank filled with a conducting solution to determine the self and mutual admittances of coupled dipoles are described. The agreement between the measured values and the theory is quite good. Author (TAB)

N66-16310# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrophysics.
MINIMUM-SCATTERING ANTENNAS
Walter K. Kahn and Herbert Kurss 7 Apr. 1964 12 p refs *Its* Memo. No. 96
(Grants AF-AFOSR-453-63; NSF GP-2761)
(PIBMRI-1215-64; AFOSR-65-1726; AD-624080) CFSTI: HC $1.00/MF $0.50

Antennas with identical patterns differ to the extent in which they modify an incident wave, ie., in the amount they scatter. An antenna is completely described by an (infinite dimensional) scattering matrix. The concept of a minimum scattering antenna introduced by Dicke is generalized to include antennas with a finite number of accessible waveguide ports and with non-reciprocal components. A canonical minimum scattering antenna is defined as one which becomes 'invisible' when the accessible waveguide terminals are open circuited. Such an antenna is shown to be unique once the independent radiation patterns have been specified. Neither an impedance nor an admittance matrix for such an antenna exists. The physical significance of the minimum scattering antenna concept is examined from several points of view. Appropriate generalizations of Dicke's results are derived for multiport and non-reciprocal antennas. The 'scattered power', is introduced as a convenient measure of scattering. It is demonstrated, for a large class of antennas, that the scattered power is quite generally greater than the absorbed power, equality being attained for minimum scattering antennas of this class. This result further justifies the minimum-scattering terminology. Arrays of canonical antennas are discussed briefly. Author (TAB)

N66-16320# Federal Aviation Agency, Washington, D. C. Systems Research and Development Service.
INSTALLATION CRITERIA FOR CAPTURE EFFECT GLIDE SLOPE
Henry H. Butts Dec. 1965 42 p
(RD-65-115)

The general theory of the capture effect glide slope which is useful at problem sites is described. Radiation patterns are plotted showing the cancellation techniques employed for eliminating energy striking discontinuities in the approach area so as to provide improvement in flyability. Details are given for generating the auxiliary signal, slightly offset in carrier frequency, which insures adequate clearance below path without derogating the flyability. A monitoring system for the new array is described in detail. Author

N66-16398# Institute for Perception RVO-TNO, Soesterberg, (Netherlands).
COMPARATIVE RESEARCH OF 7 MICROPHONES AND 3 TELEPHONES [VERGELIJKEND ONDERZOEK AAN 7 MIKROFOONS EN 3 HOOFDTELEFOONS]
R. Plomp and A. M. Mimpen Sep. 1965 15 p In DUTCH; ENGLISH summary
(IZF-1965-21; TDCK-43620) CFSTI: HC $1.00/MF $0.50

Of 7 microphones a group of 4 has shown to give the best speech communication at high noise levels. Both the sound attenuation and standard deviation of 3 telephone sets are dealt with. At a frequency of 1000 cps the impedance of the microphones and the telephones has been measured. Author

N66-16402# Frankford Arsenal, Philadelphia, Pa. Fire Control Engineering Directorate.
COMPUTER, GUN DIRECTION, M18 (FADAC) APPLICABILITY IN DEFENSE COMMUNICATION SATELLITE ANTENNA POSITIONER SYSTEM Final Report, Dec. 1964–Jul. 1965
Helen Smolen Oct. 1965 56 p refs
(R-1777; AD-624053) CFSTI: HC $3.00/MF $0.50

The study described in the report was undertaken at the request of the U. S. Army Satellite Communications Agency, Ft. Monmouth, N. J., to determine the suitability of Computer, Gun Direction, M 18 (FADAC), as the control unit in an Antenna Position Programmer System designed to acquire and track earth satellites. Results of the study show that FADAC has the capability of performing the required functions, can interface with the remainder of the system, and, at operator's option, either output control data to the antenna positioner within the real time specified, or generate a punched paper tape. Author (TAB)

N66-16432# Space Technology Labs., Inc., Redondo Beach, Calif.
CALIBRATION OF RADAR TRACKING NETWORKS USING SATELLITE DATA
T. I. Fine 30 Nov. 1964 36 p refs
(STL-9990-6815-RU-000)

Analytical and experimental results are presented to illustrate the calibration of radar tracking networks using purely electronic data. The physical principles on which such calibrations are based are discussed and the calibration results from two electronic calibrations are given. Camera data is not required by the method proposed; hence, the availability of tracking data suitable for calibration need not be restricted by weather conditions. E.E.B.

N66-16513# Illinois Univ., Urbana. Radiolocation Research Lab.
CHARACTERISTICS OF THE MONOPULSE MODE DISPLAY FOR THE WULLENWEBER RADIO DIRECTION FINDING SYSTEM Technical Report No. 16
Arnold Stephen Rosenbaum Oct. 1965 82 p refs
(Contract NObsr-89229)
(RRL-291; AD-624166) CFSTI: HC $3.00/MF $0.75

Contents: System description, computer program, simple spectrum configurations, and complex spectrum configurations. TAB

N66-16595*# National Aeronautics and Space Administration, Washington, D. C.
ELECTROMAGNETIC COMPATIBILITY PRINCIPLES AND PRACTICES
Oct. 1965 708 p refs
(NASA-TM-X-57183; NHB-5320.3) GPO: HC $3.75; CFSTI: MF $3.50 CSCL 17B

This electromagnetic compatibility principles and practices manual is presented to stimulate interest and promote understanding in the art and science of interference control throughout the Apollo project. Discussed are an electromagnetic compatibility (EMC) history and background; EMC organization and program evaluation; elements of electromagnetic interference (EMI); theoretical aspects of EMC analysis; electromagnetic characteristics of electronic parts, and functional circuits and components; grounding; bonding; shielding; packaging and equipment interfacing; filter design and application; design considerations for minimizing interference; EMI specifications; control and test plans; interference measurements, test equipment, and conditions; susceptibility; and measurement techniques. R.N.A.

N66-16613# Lenkurt Electric Co., Inc., San Carlos, Calif.
MULTIPLEXER SET AN/FCC-17( ) AND MULTIPLEXER SET AN/MCC-12, PHASE B Final Engineering Report

F. N. Easley and R. B. Anderson 29 Oct. 1965 307 p refs (Contract AF 30(635)-11188)
(RADC-TDR-63-440, Vol. II; AD-625549) CFSTI: HC$7.00/MF $1.50

The multiplexer set was designed and fabricated for reliability under extreme conditions of operation. Reliability testing under actual field conditions and with military maintenance indicates an MTBF in excess of 411 hours, although the calculated MTBF for a 60-channel system is 125 hours. Further field experience has shown the actual MTBF to be better than 800 hours and the availability of any channel to be 99.98 percent. The availability of a particular channel is 99.998 percent. TAB

N66-16618# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
A METHOD OF SOLVING THE INTEGRAL EQUATIONS FOR VERTICAL PROPAGATION OF TIME-HARMONIC ELECTROMAGNETIC PLANE WAVES IN ANISOTROPIC VERTICALLY-HOMOGENEOUS MEDIA
John M. Tomlinson 30 Dec. 1965 405 p refs *Its* Sci. Rept. 259
(Contract AF 19(628)-4014; Grant NSF GP-2914)
(AFCRL-65-872; AD-625609) CFSTI: HC $7.15/MF $2.00

The problem of formulating a rigorous mathematical description of electromagnetic wave propagation in anisotropic inhomogeneous media is dealt with in this work. This is based on a fullwave treatment. The coupled integral equations for continuous-waves are developed and methods for their solution deduced utilizing a matrix technique. Application is made to an exactly known solution as a test of the method.
Author (TAB)

N66-16650# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
OPTIMUM NONUNIFORMLY SPACED ANTENNA ARRAYS Final Report, 1 Mar.–30 Sep. 1965
M. T. Ma and L. C. Walters 30 Nov. 1965 32 p refs *Its* Rept.-510-11-5104400
(Contract PRO-S65-534)
(AFCRL-65-830; AD-625318) CFSTI: HC $2.00/MF $0.50

A formulation for synthesizing an optimum nonuniformly spaced but symmetrical array by adjusting both the amplitude excitations and element spacings is given. This is accomplished by applying Haar's theorem which is known in a branch of mathematics. It is shown that the solution obtained according to the method proposed here is optimum in the senses that, with respect to a chosen set of element spacings, (1) the maximum deviation between the synthesized and desired patterns is minimized, (2) the side lobes can be made approximately equal and their level minimum for a specified beamwidth, (3) the side lobe level and beamwidth are not seriously constrained so that a solution better than the Dolph–Chebyshev array may be possible, (4) a minimum number of elements required to synthesize a desired pattern may be determined, and (5) the solution can be unique. Author (TAB)

N66-16668# Joint Publications Research Service, Washington, D. C.
ANTENNAS AND MASTS
G. A. Savitskiy 27 Jan. 1966 21 p Transl. into ENGLISH from Antenno-Machtovyye Sooruzhe-Niya (Moscow), 1962 p 70–88 (JPRS-33926; TT-66-30369) CFSTI: $1.00

The design features of several types of short wave radio receiving and transmitting antennas are presented. The types of short wave antennas described include the wideband horizontal V with a circular radiation pattern; the wideband horizontal dipole for weakly directional work; the shunted wideband horizontal dipole; the horizontal rhombic and double horizontal rhombic, both for directional transmission; the cophasal horizontal array, and the cophasal horizontal wideband array. R.N.A.

N66-16699*# Ohio State Univ. Research Foundation, Columbus. Dept. of Electrical Engineering.
COUPLING BETWEEN PARALLEL-PLATE WAVEGUIDES BY WEDGE DIFFRACTION TECHNIQUES
L. L. Tsai, R. C. Rudduck, and R. B. Dybdal 20 Oct. 1965 55 p refs *Its* Rept.-1691-17
(Grant NsG-448)
(NASA-CR-70044) CFSTI: HC $3.00/MF $0.50 CSCL 09F

The coupling between two parallel-plate waveguides is calculated using edge-diffraction techniques. The parallel-plate guides have arbitrary truncation angles and are formed by wedges of arbitrary angular extent. Coupling is calculated for both TEM and TE_{01} waveguide modes with the results experimentally verified. Author

N66-16704*# Ohio State Univ. Research Foundation, Columbus.
ABSORPTION IN THE SUBMILLIMETER RANGE
B. J. Lin (M.S. Thesis) 15 Dec. 1965 73 p refs *Its* Rept.-1093-29
(Grant NsG-74-60)
(NASA-CR-70039) CFSTI: HC $3.00/MF $0.75 CSCL 20N

Water-vapor absorption is the most intense absorption in the submillimeter region. With a new spectrometer, the Michelson type interferometer, investigation of absorption can be extended to a lower frequency range with better resolution and accuracy. An experimental setup is described which measures the water-vapor absorption from $\nu = 10\ cm^{-1}$ to $\nu = 200\ cm^{-1}$ at a pathlength of 200 ft. and pressures of 4.4 mm Hg and 1.1 mm Hg. Theories of the water-vapor rotational line positions are reviewed. A newly constructed high temperature submillimeter source is also described. Author

N66-16724# Stanford Univ., Calif. Radioscience Lab.
EXPERIMENTAL INVESTIGATION OF THE COHERENCE DISTANCE OF THE ATMOSPHERE FOR MICROWAVES Final Report, Jun. 1961–Jul. 1965
R. N. Bracewell Aug. 1965 32 p refs
(Contract AF 19(604)-7249)
(SEL-65-083; AFCRL-65-285; AD-624991) CFSTI: HC $2.00/MF $0.50

An attempt has been made to measure the phase fluctuations of radio waves induced by the earth's atmosphere. The strong radio source Cygnus A was observed at a frequency of 3075 Mc/s using a two-element interferometer consisting of two 30-foot-diameter paraboloid antennas on equatorial mounts. The fringe pattern was recorded for periods of several hours, and the phase of each fringe, relative to a theoretical fringe pattern, was obtained. The fluctuation in the phase values shows an RMS variation of one to three times the value expected from the system noise. It is not clear whether this excess fluctuation is attributable to the atmosphere, or whether it is a measure of the limiting phase stability of the instrument. The measurements do, however, provide an upper limit to the fluctuation in the effective angle of arrival of the radio waves, which is less than one second of arc for elevation angles greater than 30 deg. A description is also given of the antennas, the equatorial mounts, and the control units developed for the traveling-wave preamplifiers. Author (TAB)

N66-16737# Scanwell Labs., Inc., Springfield, Va.
A LARGE, LOW-COST STEERABLE PLANAR ARRAY Final Report, 1 Apr. 1964–31 Mar. 1965
Clinton G. Hollins Aug. 1965 104 p refs
(Contract AF 19(628)-4039)
(AFCRL-65-757; AD-624880) CFSTI: HC $4.00/MF $0.75

Equipment and techniques developed expressly for the implementation of a low-cost steerable plannar array of approximately 10,000 elements and operating in the 100 to 200 mc region of the electromagnetic spectrum are described. Beam steering control along parallel rows is achieved by changing the interelement spacing of radiators proximity coupled to a slow wave structure while a phase shifter of new design permits simple control of the phase of the current supplied to each row, providing a second steering coordinate. Fabrication and installation of the entire array would require approximately $90.00 per element at the middle of the specified frequency range. Author (TAB)

N66-16763# Joint Publications Research Service, Washington, D. C.
RECENT ARTICLES ON CODING TECHNIQUES FOR DATA TRANSMISSION SYSTEMS
25 Jan. 1966 41 p refs Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 11, Nov. 1965
(JPRS-3381; TT-66-30324) CFSTI: $2.00

Three articles are presented on the general subject of data transmission systems. A method for forming a protective code and the process for designing coding and decoding equipment for a simplex communications channel are described. Also, the use of magic squares for error correction codes are considered. In the third article an expression is obtained for the case of a binominal distribution of errors in the direct and return channels for the length of the combination of feedback signals at which the maximum effectiveness of systems for data transmission using a return channel is attained. E.E.B.

N66-16764# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 282 Analysis of a New Method of Focusing an Electron Beam
28 Jan. 1966 28 p refs Transl. into ENGLISH from CHINESE Periodicals
(JPRS-33942; TT-66-30385) CFSTI: $1.00

This paper presents a research on a new compound type static focusing system. The static rotating focusing and the periodical static focusing are used in this system. The analysis shows that there are two different states: the electron movement is the vibration equation of reactions due to the periodic force, and the similar elastic force. They can be combined as the uneven order Mathieu equation. The characteristic of the first type is that it can produce resonant effect to destroy the equilibrium and stability of the system. The periodic solution within a stable region is obtained from the other type. The electron beam is in equilibrium in the nonperiodic field, and the first stage occurs when there is the effect of the additional periodic field. With the focusing conditions and the current equations of different states, two structure calculation equations are obtained. Author

N66-16918*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MERCURY NETWORK ANALYSIS FOR MA-8
24 Oct. 1962 111 p
(NASA-TM-X-55366; X-551-62-192) CFSTI: HC $4.00/MF $0.75 CSCL 17B

Overall performance of the Mercury network during the Mercury Atlas, MA-8, mission in 1962 is reviewed from countdown to completion. An instrument evaluation of radar tracking and acquisition, telemetry and timing, air/ground voice communications, and command is included, along with the various aspects of the ground communications system. Considering the poor propagation forecast for the mission period, network ground communications were reported to be good. The computer system performance during the various phases of the mission is evaluated, and the various performance tests are reviewed. Configuration and performance of the Mercury network, location of Mercury sites and equipment at each, and system test charts are included. M.W.R.

N66-16931# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
EVALUATION OF UHF ANTENNA COUPLERS, TYPES CU-691/U AND CU-692/U Final Report
James G. Dong Nov. 1965 44 p refs
(RD-65-124)

Laboratory tests were conducted on UHF Antenna Couplers, Types CU-691/U and CU-692/U to determine their suitability for FAA use. The CU-691/U Coupler was designed for four-channel operation and the CU-692/U, two-channel operation. Both systems employed passive networks comprised of tandem coaxial cavities operating as selective filters. These filters, and a suitable matching network combination, were designed to provide the capability of connecting more than one transmitter and/or receiver to a single antenna. Measurements were made of such operating parameters as VSWR, selectivity, insertion loss, and isolation. Orbital flight patterns of the antenna radiation, when utilizing the Antenna Coupler, Type CU-691/U, were also accomplished. Based on the results of the evaluation, it was concluded that the Antenna Couplers, as designed, were suitable for FAA use. It was recommended that the use of these Antenna Couplers be considered in the planning of Remote Communication Air/Ground Systems. Author

N66-16944# Joint Publications Research Service, Washington, D. C.
TELEGRAMS THROUGH SPACE
V. Belikov 25 Jan. 1966 9 p Transl. into ENGLISH from Izv. (Moscow), 30 Dec. 1965 p 1
(JPRS-33876; TT-66-30319) CFSTI: $1.00

The Soviet communications satellite, Molniya 1, is described. Its potential for serving large areas with telephone, telegraph, and television communications is discussed. R.N.A.

N66-16992# Philco Corp., Palo Alto, Calif. Western Development Labs.
SATELLITE COMMUNICATION CONTROL FACILITY First Quarterly Progress Report, 17 May–31 Aug. 1965
8 Oct. 1965 43 p refs *Its* Rept.-1
(Contract DA-28-043-AMC-01379(S))
(WDL-TR2684; AD-624643) CFSTI: HC $2.00/MF $0.50

Satellite Communication Control Facility (SCCF) Project provides a means for scheduling the Initial Defense Communication Satellite Program (DCSP) Facilities and resources, using manual techniques. The project includes the development of scheduling techniques, determination of the interfaces, development of operating procedures, and the delivery of the SCCF together with a trained schedule-control team of government personnel. TAB

N66-16996# Harry Diamond Labs., Washington, D. C.
DIGITAL GENERATION OF BAND-LIMITED GAUSSIAN NOISE
Badrig M. Kurkjian 25 Oct. 1965 16 p refs
(HDL-TM-65-49; AD-624689) CFSTI: HC $1.00/MF $0.50

The report gives a method for generating a set of random variables, equally spaced, τ time units apart, from a Gaussian noise function y(t) with specified power spectrum $p_o(\omega)$. The particular spectrum $p_o(\omega) = \frac{A^2a^2}{a^2 + \omega^2}$; $\omega > 0$ is treated as an illustration. The noise signal y(t) can be thought of as the output of a linear system (e.g., a simple rc filter) with transfer function h(j ω), where the input signal is Gaussian white noise x(t) with flat spectrum of constant amplitude A^2.
Author

N66-17011# Radiation, Inc., Melbourne, Fla. Antenna and Microwave Engineering Section.
STUDY OF SPECIAL BEAMSHAPING ANTENNAS Third Quarterly Report, 1 Mar.–31 Aug. 1965
H. E. Bartlett and R. K. Oishi [1965] 62 p ref
(Contract DA-28-043-AMC-00389(S))
(Rept.-8; AD-624603) CFSTI: HC $3.00/MF $0.75

The report describes the progress during the past six months of a program to develop dielectric elements for use in lightweight, highly-transportable satellite communications antennas. A very large part of the effort during this period went into the publication of a Design Plan describing a four-element array of reflector antennas using Dielguide Cassegrain feeds. This array provides the gain of a conventional fifteen foot parabolic antenna with a total weight (array, pedestal, and trailer) of 663 pounds. A brief description of this array and its performance characteristics (taken from the Design Plan) are presented. Progress on the development of a Monopulse DIELGUIDE Cassegrain feed is reported. The thick-wall tube dielectric endfire element has been investigated and found to have about 1-1/2 times the width and 1/4 the length of a dielectric rod antenna with the same gain.
Author (TAB)

N66-17012# Sylvania Electric Products, Inc., Waltham, Mass.
SURFACE WAVE BEHAVIOR IN PHASED ARRAYS Quarterly Progress Report
28 Oct. 1965 31 p refs
(Contract AF 30(602)-3886; ARPA Order 723)
(QPR-1; AD-624308) CFSTI: HC $2.00/MF $0.50

Mutual coupling in phased arrays causes their active impedance to vary with the electrical phasing used to scan the array. Large impedance mismatches can accrue if many coupling contributions add in-phase. This happens when the steering phase advance equals the mutual coupling phase delay between consecutive elements. For these critical scan directions, reflections can be very large and the antenna array will transmit or receive very little power as evidenced by deep holes in the element radiation pattern. Element radiation pattern and active array mismatch are shown to be equivalent representations of phased array scanning performance. A large, flat, uniformly spaced, array of identical elements is analyzed. A relation is found between the critical scan angle and mutual coupling coefficients. Radiation pattern and coupling phase measurements in an array are presented in support of the analysis.
Author (TAB)

N66-17020# Naval Civil Engineering Lab., Port Hueneme, Calif.
ELECTROMAGNETIC SHIELDING EFFECTIVENESS MEASUREMENTS USING LOW CONDUCTIVITY CLOSED SURFACES Technical Report, Jun.–Sep. 1964
H. A. Lasitter Dec. 1965 30 p refs
(R-416; AD-624708) CFSTI: HC $2.00/MF $0.50

In an investigation to predict the shielding effectiveness of low-conductivity materials used in electromagnetic-interference-shielded structures. The symmetrical configuration of a spherical shell was adapted to approximate the closed walls of a normally cubical or rectangular shielded enclosure. A hemisphere was used for the experiments and a half cube with the same surface area and conductivity (0.1 mho/meter) was used for comparison of an equivalent rectangular structure. In measurements over a frequency range of 20 to 900 Mc (or MHz), the half cube showed a greater shielding effectiveness than the hemisphere over a major portion of the frequency range. The primary advantage of the hemisphere is the ability to predict the absorption over a wide band of frequencies. The conductivity of the materials used in this investigation was found to exhibit an empirical relationship with frequency range, described by $\log (\sigma/\sigma_{dc}) = 0.236 \log F$.
Author (TAB)

N66-17030# Stanford Research Inst., Menlo Park, Calif.
MEASUREMENT OF IONOSPHERIC EFFECTS ON CURTS SOUNDER/COMMUNICATIONS TERMINAL SEPARATIONS Final Report
Harry A. Turner Jun. 1965 92 p refs
(Contract DA-28-043-AMC-00082(E))
(FR-2; AD-624253) CFSTI: HC $3.00/MF $0.75

This report describes experimental work concerned with the variation of selected oblique-incidence ionogram parameters (LOF, MOF, and mode MOF) as the location of the sounder terminal is moved. In the experiment, sounder transmitters were located at Fort Monmouth, New Jersey and at San Angelo, Texas. One receiver was fixed at Mountain View, California, while two mobile receivers were located at various distances, up to 300 km, east and north of Mountain View. A prediction technique is presented for estimating the parameters at a distant site when their values are known at a reference location. Observation of the two mid-latitude paths during time of geomagnetic calm show that ionospheric effects increase MOF and mode MOF rms prediction error by about 0.1 Mc per 100 km and increase LOF prediction error by about 0.05 Mc per 100 km. Geomagnetic disturbances can increase the prediction error by a factor of at least two. Application of the results to representative nodes in the DCS HF communications network is discussed in detail, with examples. The effects of site topography, equipment differences, and temporal prediction errors are evaluated. The extent to which the conclusions can be applied to other paths and seasons and to ionospheric disturbed periods is discussed.
Author (TAB)

N66-17042# California Univ., Berkeley. Electronics Research Lab.
SURFACE WAVES ON ANISOTROPIC SURFACES
Michael J. Gans 19 Oct. 1965 198 p refs
(Grant AF-AFOSR-139-65)
(ERL-65-26; AD-624602) CFSTI: HC $5.00/MF $1.25

The main problem treated is the determination of the electromagnetic characteristics, i.e., the velocity of propagation, power flow, etc., of surface waves guided by various surfaces on which the current is constrained to flow along parallel sinusoidal paths. The purpose was to learn more about the behavior of waves on periodic anisotropic surfaces and to apply this knowledge, where possible, to obtain a clearer understanding of the method of operation of log-periodic antennas. Rumsey's continued fraction solution for the propagation characteristics of surface waves on the single sinusoidally anisotropic

plane is extended to two parallel sinusoidally anisotropic planes, to the circular cylindrical sinusoidally anisotropic surface, and to the sinusoidally corrugated sheet. For surface waves on the single sinusoidally anisotropic plane, the following properties are determined: direction of power flow with respect to direction of propagation, the Floquet coefficients of the series which describes the surface wave fields, an integral representation of the summation of the Floquet series, the geometrical requirements for resonating a surface wave, and the propagation characteristics for the special cases of very low frequency and of propagation at the velocity of light perpendicular to the axes of the sinusoids. On the basis of power conservation, approximate power flow diagrams are given for leaky waves and surface waves in general.

Author (TAB)

N66-17082*# International Business Machines Corp., Rockville, Md. Federal Systems Div.

ORL EXPERIMENT PROGRAM, VOLUME B. PART VI: COMMUNICATIONS AND NAVIGATION/TRAFFIC CONTROL

21 Feb. 1966 146 p refs

(Contract NASw-1215)

(NASA-CR-70346) CFSTI: HC $4.00/MF $1.00 CSCL 17B

An illustration is presented which concerns the application of a previously derived synthesis framework to constructing an Orbital Research Laboratory (ORL) experiment program in support of communications and navigation/traffic control. The object of this experiment area is to meet public and national needs for global communications and related services. Consideration is given to the identification of selected knowledge requirements and the derivation of experiment requirements. These include equipment functional and supporting research requirements, and prospective orbital activities. Appendices include illustrative SKRs and representative experiments for communications and navigation/traffic control, and discussions of the benefits from an integrated SATC traffic control and navigation system. C.T.C.

N66-17093*# Illinois Univ., Urbana. Coordinated Science Lab.

HIGH RESOLUTION RADIO FREQUENCY MEASUREMENTS OF FARADAY ROTATION AND DIFFERENTIAL ABSORPTION WITH ROCKET PROBES

H. Knoebel, D. Skaperdas, J. Gooch, B. Kirkwood, and H. Krone Dec. 1965 147 p refs

(Grant NsG-504; Contract DA-28-043-AMC-00073(E))

(NASA-CR-70319; R-273) CFSTI: HC $4.00/MF $1.00 CSCL 09F

A system for lower ionosphere radio propagation measurements, using probe rockets, is described in detail. Unique features include (1) feedback around a closed loop consisting of the rocket and ground stations employed in a null-seeking technique, which increases absorption measurement accuracy and (2) artificial rotation of the ground based antenna which extends the range over which Faraday rotation can be resolved from layer reflection phenomena. The rocket borne and ground station equipment were shown to work reliably during a series of 14 rocket measurements. Complete engineering information is given, and data processing techniques for smoothing and improving the accuracy as well as some typical data are described. Author

N66-17102# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF SHORT-WAVE RADIO COMMUNICATION THROUGH THE POLAR ZONE

K. M. Kosikov, Yu. A. Chernov et al 9 Nov. 1965 7 p Transl. into ENGLISH from Russian Patent No. 165781 (Appl. No. 12538/26-9, 4 Jan. 1963) 2 p

(FTD-TT-65-819/1+2+4; AD-624859) CFSTI: HC $1.00/MF $0.50

A method is proposed for short wave radio communication across the polar zone. The method is different from known ones in the fact that the maximum diagrams of directivity of the antennas are oriented at some angle to the direction of the correspondent within limits up to 120 degrees. With such an orientation of the antenna, the level of the receivable signal increases in comparison with the orientation of the antenna along the azimuth. C.T.C.

N66-17222*# Alabama Univ. Research Inst., Huntsville.

ON DIELECTRIC LENSES

N. F. Audeh and H. Y. Yee [1965] 8 p refs Submitted for Publication

(Grant NsG-608)

(NASA-CR-60259) CFSTI: HC $1.00/MF $0.50 CSCL 20N

A method for eliminating the problem of electromagnetic wave propagation in parallel-plane waveguides, i.e., the problem of launching the waves, by the use of a dielectric lens is discussed. The shape of the lens is determined by the fact that the electrical distance traveled through the air plus that traveled through the lens is equal to the electrical equivalent of the constant distance. The phase front is usually spherical due to a point source or circular due to a line source. If the source is a horn the flux plot is no longer perfectly circular. The shape of the lens can be determined by the imposed condition that the distance a wave front travels in an empty waveguide plus the distance the same front travels in the dielectric filled portion of the guide is equal to the constant electrical distance. Equations for this condition are given. E.E.B.

N66-17234*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

10.6 MICRON COMMUNICATION SYSTEM

Nelson Mc Avoy Nov. 1965 26 p refs

(NASA-TM-X-55396; X-524-65-461) CFSTI: HC $2.00/MF $0.50 CSCL 17B

Based on an analysis of existing operable equipment, or equipment which will shortly be available, it is proposed that the 10.6 micron wavelength be adopted for deep space laser communication systems. The mathematics are briefly outlined which show that with existing optical receivers the minimum detectable power signal cannot be achieved in the radio frequency microwave or millimeter ranges. Next, practical telescope apertures, laser transmitter antenna gains, and practical limitations of pointing transmitters are considered; and it is suggested that the aperture for existing infrared diffraction limited telescopes be not less than one meter. Further, it is shown that the lowest laser frequency which may be used with a one meter aperture is in the 10 micron region. Also discussed are (1) atmospheric absorption and scatter; (2) atmospheric distortion of the plane isophasel surface of the transmitted beam; and (3) Doppler shift of the transmitted beam and its effects on reception. Finally, a complete set of parameters is proffered for a telemetry link between a Mars borne laser probe and receivers on the Earth. D.T.

N66-17255*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE GODDARD RANGE AND RANGE RATE TRACKING SYSTEM: CONCEPT, DESIGN AND PERFORMANCE

G. C. Kronmiller, Jr., E. J. Baghdady (ADCOM, Inc.) Oct. 1965 90 p refs
(NASA-TM-X-55382; X-531-65-403) CFSTI: HC $3.00/MF $0.75 CSCL 17I

This paper is concerned with the concept, evolution and performance analysis of a high-accuracy, near-earth and cislunar cooperative target tracking system, known as the Goddard Range and Range Rate System. This system combines the advantages of harmonic (or sidetone) and pseudo-random coded ranging signals in a highly effective and versatile manner, operable either as an all-harmonic system in near-earth orbital tracking or as a hybrid system for tracking more distant spacecraft. The system also combines the utilization of the two types of signals in a very attractive technique for speeding up the process of acquiring the ambiguity resolving code component in tracking spacecraft at cislunar and translunar distances. The theoretical analysis of system performance and errors is followed by a summary of performance data gathered to date by operating GRARR systems on a number of NASA missions. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N66-16212# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
SYSTRAN (SYSTEMS ANALYSIS TRANSLATOR): A DIGITAL COMPUTER PROGRAM Technical Report, Aug. 1962–Oct. 1964
David J. La Jeunesse, E. B. Weis, Jr., and T. J. Hogan, Jr. (Technology, Inc.) Jul. 1965 322 p refs
(Contract AF 33(616)-10010)
(AMRL-TR-65-133; AD-624468) CFSTI: HC $7.00/MF $1.50

The mechanics, mathematics, and usage of a program written in FORTRAN IV and MAP for the IBM 7094 are described. The program is called SYSTRAN (Systems analysis translator) and it includes subroutines for most of the common tools for frequency domain analysis of linear systems (such as Fourier transforms and inverse Fourier transforms, complex algebra, and correlation functions). The report is essentially an instruction manual. It contains a discussion of all aspects of the program essential to competent usage. Author (TAB)

N66-16414*# Sperry Rand Corp., Blue Bell, Pa. UNIVAC Div.
RELIABLE MINIATURE SPACEBORNE MEMORY Interim Engineering Report, 19 Nov. 1964–6 Jul. 1965
(1965) 262 p refs
(Contract NAS5-9518)
(NASA-CR-69850) CFSTI: HC $6.00/MF $1.50 CSCL 09B

The design of the memory system and the low power circuits were completed, and the breadboard versions of the circuits and memory plane were operated and tested. The memory interface with external equipment, and the internal organization of the memory are described in detail; and a description of the timing and control circuits operation and the results of some approximate reliability calculations are presented. Also discussed are: (1) a brief description of all the circuits; (2) the plated-wire memory element, the operation, and various tests performed preliminary to the writing of a test specification, as well as the results of life tests on the wire; (3) the design, construction, and materials used in the memory planes and stack; and (4) parts lists, hybrid circuit and semiconductor specifications, information about corrosion protection of plated wires, and information about the materials used in construction of the memory. R.R.D.

N66-16423# Hazeltine Technical Development Center, Inc., Indianapolis, Ind. Electronics Div.
BINARY-TO-VIDEO DATA CONVERTER Final Report
Gerald E. Fenimore, William R. Mc Connell, Leland M. Nave, Robert J. Wulfekuhl, and Larry G. Henschen Griffiss AFB, N. Y., RADC, Feb. 1964 49 p
(Contract AF 30(602)-2856)
(RADC-TDR-63-427; AD-434759) CFSTI: $4.60

A study was made of various techniques for a binary-to-video converter suitable for accepting binary information from a computer (or similar type of input) and producing a display on a TV raster. Information to be shown on the display included alpha-numerics, symbols, map data, and similar processed-data readout in the form used for command and control displays. It is concluded that a data converter system capable of storing a digital representation of entire TV rasters would provide the most satisfactory solution. Where a number of different display pictures are to be assembled for simultaneous viewing by different persons at different local areas, a common system with a magnetic drum which provides multiple outputs is recommended. Time sharing most of the common system elements will provide a substantial savings in overall cost. A feasibility model utilizing the data converter concept was built and delivered to Rome Air Development Center, Griffiss Air Force Base, Rome, New York. For economic reasons, a small size core memory was used in place of a full size magnetic drum for video data storage. Author (TAB)

N66-16459*# Maryland Univ., College Park. Computer Science Center.
PATTERN RECOGNITION: V. SAMP-A COMPUTER PROGRAM FOR ESTIMATING SURFACE AREA FROM CONTOUR MAPS
Mark S. Monmonier, John L. Pfaltz, and Azriel Rosenfeld Aug. 1965 52 p refs
(Grant NsG-398)
(NASA-CR-69864; TR-65-21) CFSTI: HC $3.00/MF $0.50 CSCL 09B

A FORTRAN program has been written which computes a linear approximation to the surface area of any given portion of a digitized contour map. The program also estimates the slope gradient at each point. It is slower, but appears to be somewhat more accurate, than other proposed methods of estimating average slope from contour maps. Author

N66-16475# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ANALOG GENERATOR FOR REAL-TIME DISPLAY OF CURVES Technical Report No. 398
Timothy E. Johnson 28 Jul. 1965 26 p refs
(Contract AF 19(628)-5167)
(ESD-TDR-65-312; AD-623945) CFSTI: HC $2.00/MF $0.50

The report discusses the design and performance of a low-cost analog generator capable of forming rotated cubics and conics for real-time display on a cathode-ray tube. Use of high-bandwidth operational amplifiers and field-effect transistors in the analog switches allows fast and accurate operation. Author (TAB)

N66-16521# Naval Research Laboratory, Washington, D.C.
CODE AND SEQUENCING SYSTEM FOR AUTOMATIC WEATHER STATIONS
T. E. Marshall, III and R. B. Bridge 25 Jun. 1964 66 p refs (NRL-6092; AD-603311) CFSTI: HC $4.00/MF $0.75

Meteorological and oceanographic information is frequently required from critical areas where routine environmental observations are either not made or can be made only at considerable expense and time. As part of a continuing program to develop environmental telemetering equipment for obtaining data from remote or inaccessible regions, a code and sequencing system was developed. This system includes an analog-to-digital converter which employs a cyclic Morse-code number system. This number system eliminates all possibility of ambiguity as the output changes from any digit to any other digit. The code and sequencing system consists of a multiplexer, encoder, and parallel-to-serial code converter. The system translates the resistance of transducer elements of 17 words per minute. The information is in the form of three-letter groups. The first letter identifies the information channel. The second and third letters provide the transducer readout which will be one of 196 possible two-character words. Author (TAB)

N66-16636# Michigan Univ., Ann Arbor. Information Systems Lab.
MONOTONE CONGRUENCE ALGORITHMS
Richard F. Arnold and Donald L. Richards Apr. 1965 27 p refs *Its* Rept.-06920-2-T
(Contract AF 30(602)-3546; Grants AF-AFOSR-367-63; AF-AFOSR-367-64; NSF GP-2778)
(ISL-65-2; AD-625046) CFSTI: HC $2.00/MF $0.50

Given an associative system in which each element is assigned a cost and in which an equivalence relation obtains between elements, it is often of interest to ask the question: what is the least costly word equivalent to a given word? The case in which the equivalence relation is a two-sided congruence relation is studied here, one example being the problem of optimizing a type of computer program. Such optimizing processes may be formalized as Markov normal algorithms. A general result concerning order relations on finite alphabets is established first. Then, the properties of a class of Markov normal algorithms are investigated, it is shown that each such algorithm must always terminate, and that every class of mutually equivalent algorithms contains a unique minimal algorithm which can be obtained by applying any algorithm of the class to itself. Author (TAB)

N66-16683# System Development Corp., Santa Monica, Calif.
DETERMINISTIC CONTEXT FREE LANGUAGES Scientific Report No. 4
Seymour Ginsburg and Sheila Greibach (Harvard Univ.) 7 May 1965 44 p refs
(Contract AF 19(628)-3418)
(TM-738-014-000; AFCRL-65-415; AD-624938) CFSTI: HC $2.00/MF $0.50

A number of results about deterministic languages (languages accepted by pushdown automata with no choice of moves) are established. In particular, (1) each deterministic language is unambiguous, (2) the complement of each deterministic language is a deterministic language. (3) numerous operations which preserve deterministic languages (for example, intersection with a regular set) are obtained. (4) several problems are shown to be recursively unsolvable. Author (TAB)

08

N66-16803# Applied Physics Lab., Johns Hopkins Univ., Silvers Spring, Md.
TABLE OF ERROR CORRECTING AND ERROR DETECTING FIRE CODES THROUGH GENERATOR DEGREE 33
Patrick T. Komiske 12 Feb. 1964 51 p refs
(Contract NOw-62-0604-c)
(CF-3068; AD-622489) CFSTI: HC $3.00/MF $0.50

The binary fire codes are produced by a generator polynomial g (x)=p (x) (x^{2-1}), where p (x) is of degree m. The codes are capable of correcting any single burst of errors of length b or less and of detecting any combination of two bursts of which the length of the shorter burst is no greater than m and the sum of the lengths is no greater than c+1 as well as any single burst of length no greater than c+m, the number of check bits. The tables are formatted to facilitate selecting a particular code by listing in increasing order the burst correcting capability, increasing order of the irreducible polynomial exponent, and increasing magnitude of the check symbols, respectively. The power of the error burst detector, number of check symbols, code length, transmission efficiency, and order of the roots of the irreducible polynomial are listed. TAB

N66-16863 Naval Research Lab., Washington, D. C.
AUTOMATED LOGGING AND PROCESSING OF THE NRL CYCLOTRON MAGNETIC FIELD DATA
John L. Toth, C. D. Bond, R. G. Allas, A. G. Pieper, and R. B. Theus *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 415–420 refs (See N66-16826 07-23)
CFSTI: $8.50

An automatic tape controlled data logging assembly is described which together with subsequent computer processing of the output, provides a system for obtaining magnetic field data with a minimum of personnel. A Hall-effect transducer was selected for the field measurements because of its reliability, usability in high gradients, and ease of rapidly recording the Hall voltage with a digital voltmeter (DVM); schematics show the probe positioning table, and the positioning control system. The sequence of probe positions and data recording is under punched paper tape control. These computer-prepared tapes specify polar or cartesian traversals, coordinate increment size, mapping boundaries, and the DVM readings to be recorded at any mapped point. The input drive tape format also provides for programming several variations in recording DVM voltages; these are listed. The data processing codes are built around a Fortran deck, and provide for graphic output on a digital plotter. Field data are accepted in either rectangular or polar coordinates, but it is pointed out that the rectangular mode was selected for the majority of measurements. M.G.J.

N66-16989# RAND Corp., Santa Monica, Calif.
SIMULATION PROGRAMMING AND ANALYSIS OF RESULTS
Allen S. Ginsberg May 1965 11 p refs Presented at Simulation Panel of the Dept. of Defense Logistics Conf., Warrenton, Va., 26–28 May 1965
(P-3141; AD-615303) CFSTI: HC $1.00/MF $0.50

Techniques are discussed that have arisen for simplifying and speeding development of digital simulation and for increasing the meaningfulness of their results. SIMULATION PROGRAMMING: Of programming languages for a simulation model, the General Purpose Systems Simulator II (IBM DP Div., B20-6346, 1963) should be used if it is adaptable and if memory limitations and running time are not excessive; otherwise SIMSCRIPT (B. H. Markowitz and H. Karr, 'SIMSCRIPT: A Simulation Programming Language,' Englewood

Cliffs, N. J., Prentice Hall, April 1963) or other languages should be used. The method of Ginsberg, Markowitz, and Oldfather (AD-613 976) for programming by questionnaire eliminates the need for learning a formal simulation language and reduces the time for obtaining a program to a matter of days or hours. ANALYSIS OF RESULTS: The complication of the variability of simulation results has been approached by Conway (AD-287 527) regarding the time series aspect and by Fishman and Kiviat (AD-612 281) regarding spectral analysis. TAB

N66-16998# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS TECHNOLOGY. V: SOVIET PROCESS CONTROL COMPUTERS
Willis H. Ware and Wade B. Holland, ed. Nov. 1965 91 p refs Transl. into ENGLISH from RUSSIAN
(Contract AF 49(638)-66-C-0001; Proj. Rand)
(RM-4810-PR; AD-624290) CFSTI: HC $3.00/MF $0.75

This Memorandum details eight recently developed Soviet control computers, all of which are either presently being produced or are scheduled for production. The eight include: 'Dnepr' (UMShN), UM-1-NKh, VNIIEM-1, VNIIEM-3, UM-1, 'Stal'-2', 'Zenit-3', and MPPI-1. The information on these machines is in the form of heavily annotated translations from Soviet source material. All pictures and diagrams from the original source items are included, as well as several photographs from other sources. An appendix contains an alphabetical listing of all abbreviations used in the original Russian texts. TAB

N66-17073*# Bendix Corp., Baltimore, Md. Friez Instrument Div.
RADIOSONDE AUTOMATIC DATA PROCESSING SYSTEM 1146450-2 Final Report
R. A. Jendrek and J. H. Stoudenmire Jan. 1965 31 p
(Contract NAS8-11691)
(NASA-CR-70309) CFSTI: HC $2.00/MF $0.50 CSCL 09B

This report describes an operational automatic radiosonde data processing system developed for use with the AN/GMD-2 rawin set. The method of reliably identifying the time-shared temperature, humidity and reference frequency information from a modified AN/AMQ-9 radiosonde is described. Author

N66-17103# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC OPERATIONAL MEMORY DEVICE OF AN INFORMATION-LOGICAL MACHINE
K. K. Briling and L. S. Levinskiy 10 Nov. 1965 22 p refs Transl. into ENGLISH from Nauchno'-Tekhn. Inform. (Moscow), no. 1, 1965 p 32-37
(FTD-TT-65-1562/1+2+4; AD-624853) CFSTI: HC $1.00/MF $0.50

Results are presented on the development of a complex adjustment and experimental exploitation of a magnetic operational memory device for 16384 numbers (MOZU-16000). Discussed is a problem of reducing the number of tubes and semi-conductor elements in memory devices; proposed is a multistage system of selecting the address with the use of ferrite-triode current switches and a commutation system in the recording circuit; bases are given for the use of a system with direct selection in MOZU-16000. Author (TAB)

N66-17114# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE DATA RECOVERY CENTER TARGET SIMULATOR
Josef H. Halberstein, A. H. Flink, O. V. Fortier, P. J. Harris, R. M. Martinson et al 17 Sep. 1965 34 p ref *its* Tech. Note 1965-42
(Contract AF 19(628)-5167; ARPA Order 600; Proj. Defender)
(ESD-TDR-65-445; AD-624382) CFSTI: HC $2.00/MF $0.50

It is very important for the operation of the Lincoln Data Recovery Center to be able to inject into it artificially generated targets. These target-pulses must simulate as closely as possible those appearing in the input from the I.F. tape into the D.R.C. and should be controllable in range, width, amplitude, phase and repetition rate by special computer programs written for the CDC-3200 computer. In addition to the FM channels of the tape, its digital channels must be simulated. A target simulator was constructed to the above specifications and is described. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N66-16196# Texas Instruments, Inc., Dallas. Semiconductor–Components Div.
LOW-NOISE L-BAND TRANSISTOR AMPLIFIER Fourth Quarterly Report 1 Mar.–31 May 1965
Leslie W. Read 11 Oct. 1965 60 p refs
(Contract DA-28-043-AMC-0019(E))
(Rept.-03-65-97; AD-624614) CFSTI: HC $3.00/MF $0.75

The report summarizes the work done during the period from 1 March 1965 to 31 May 1965 to design and develop a low-noise L-band amplifier, utilizing germanium planar transistors. The amplifier consists of three stages. Stripline interstages are used to transform the transistor input of one stage to an appropriate load for the preceding stage. The amplifier provides a flat gain a linear phase shift and a low noise figure in the L-band region (1.2–1.4 GHz). The basic design techniques for the prediction of circuit performance at lower frequencies are valid in the L-band region. The noise figure of the amplifier can approach the theoretical minimum over fairly narrow bands. Future work in microwave characterization will probably be done with 50 ohm source impedances and load terminations on the devices. Further work is necessary to investigate the compromises involved in minimizing noise figure over a much broader bandwidth. Author (TAB)

N66-16206*# Pan Technical Systems, Inc., Montrose, Calif.
ELECTRONIC COMPONENT PARTS RELIABILITY EVALUATION TEST: CERAMIC CAPACITORS, TUBULAR AND FLAT Final Report
Henry F. Schoemehl 17 Sep. 1965 481 p Prepared for JPL
(Contracts NAS7-100; JPL-951040)
(NASA-CR-69903) CFSTI: HC $7.81/MF $2.50 CSCL 09A

This report describes the tests performed and results obtained in evaluation of 10 types of miniature ceramic capacitors not currently covered by Military Specifications to a series of environmental and operating stresses. The purpose of the tests is as follows: (1) To accurately determine the suitability

of these types of parts for spacecraft application. (2) To determine differences in reliability between various manufacturers, both as a function of environmental stresses and electrical and thermal stress levels. (3) To determine the validity of a Screen or Burn-In on subsequent parts performance. (4) To determine or verify the existence of temperature and voltage acceleration factors during life testing. (5) To develop information such as "passed" or "failed" statistical data relating to the parametric behavior of the parts throughout the test series. Section II of this abstract provides an account of this test insofar as parts tested, tests performed and results obtained based upon catastrophic failures alone. Author

N66-16211# Naval Ordnance Lab., Corona, Calif. Fuze Dept.
MICROWAVE ATTENUATORS AND TERMINATIONS, A SIMPLE TECHNIQUE FOR FABRICATION IN THE LABORATORY
Fred H. Camphausen, Jr. 15 Oct. 1965 9 p
(NAVWEPS-8830; AD-623883) CFSTI: HC $1.00/MF $0.50

Absorbing elements for X-band waveguide attenuators and terminations can be made successfully from flexible-foam absorbing material with the use of simple tools. Any insertion loss greater than 3 dB can be produced immediately by trimming the length of the element. In addition to providing design data, techniques are described for fabricating the fixed attenuators and terminations. These techniques avoid the complex machine cuts and close tolerances required when blocks or strips of rigid microwave-absorbing material are used. Author (TAB)

N66-16215# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
THIN FILMS FORMED BY ELECTROCHEMICAL REACTIONS Interim Summary Report, 1 Jun. 1964–31 May 1965
R. Scot Clark and Coy D. Orr Jun. 1965 78 p refs *Its* Rept.–2
(Contract DA-36-039-AMC-02324(E))
(TI-03-65-71; AD-623955) CFSTI: HC $3.00/MF $0.75

Reactively sputtered thin films of tantalum oxide deposited onto thermally oxidized silicon offer a very wide range of sheet resistivities. The application of an external d-c bias to the substrate during sputtering alters sheet resistivity with no change in film thickness. Resistors of 237 ohms/sq changed less than 3% after 1000 hours at +125C and 2.5 watts/sq inch. Sputtering variables were investigated and optimized to improve resistor parameters. Reactively sputtered Ta_2O_5 dielectric films deposited onto aluminum electrodes offer capacitance values from 0.3 to 3.0 pF/sq. mil and d-c breakdown voltages of 60 to 6 volts, respectively. Capacitors tested for 1000 hours at +125C and 60% of destructive breakdown voltage changed less than 2% from initial capacitance. Substrate biasing during deposition can be used to improve the dielectric strength. Sputtering variables were investigated and optimized to improve capacitor parameters. A 455 kc amplifier is being used as a test vehicle for fabrication of a hybrid/monolithic circuit. The substrate is silicon with diffused transistors and thin film resistors and capacitors are deposited on the substrate. Author (TAB)

N66-16217# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A DEVICE FOR DELAYING IMPULSES
V. P. Antipenkov 24 Sep. 1965 6 p Transl. into ENGLISH from Russian Patent no. 158153 (Appl. no. 803153/26–24, 14 Nov. 1962) 2 p
(FTD-TT-65-469/1+4; AD-622346) CFSTI: HC $1.00/MF $0.50

The device for delaying impulses consists of a cold cathode thyratron with anodes connected together through the resistance to the power source and connected to the circuit of RC cathodes by a ladder network. The device is different in that, to increase the accuracy of work in measuring feed voltages, a comparator (on the output of which a signal arises at the moment the cathode potentials are balanced) is connected between the cathodes of the thyratrons. Author (TAB)

N66-16252*# Electra Mfg. Co., Independence, Kans.
ACCELERATION FACTOR DETERMINATION FOR METAL FILM RESISTORS Quarterly Progress Report No. 1
[1965] 48 p
(Contract NAS8-11076)
(NASA-CR-69970) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Nine hundred test resistors were serialized to maintain positive identification and noise measurements were performed on each with the test resistor in the circuit but no current passing through it, as well as with current passing through the resistor. The magnitude of the noise voltage was determined from the difference in measurements. Histograms of the various noise tests and scatter plots of the distortion analyzer measurements versus the test set measurements are included in the data section of this report. G.G.

N66-16256# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE INTERCHANGEABILITY OF VACUUM TUBE AND SEMICONDUCTOR INSTRUMENTS
B. V. Katsnel'son 28 Sep. 1965 12 p Transl. into ENGLISH from Standartizatsiya (Moscow), no. 9, 1964 p 43–46
(FTD-TT-65-897/1+4; AD-622763) CFSTI: HC $1.00/MF $0.50

Uniformity among test methods, and their standarization for interchangeability of such electronic instruments as radio tubes and transistors, are stressed since interchangeability of such instruments is believed attainable only when they are checked in comparable, identical conditions. The following Russian standards are listed as contributing to the possibility of interchange: junction dimensions for prongs of vacuum tubes, GOST 784264, for octal tube sockets, GOST 2790-64, and for minature sockets, GOST 10777-64; GOST 345-64 for plastics heads for sockets of vacuum tube instruments; GOST 2182-63 for the filament and anode voltages of vacuum tube instruments with solid incandescent cathode; GOST 7428-63 for the requirements for radio tubes with an anode that continuously dissipates power up to 25 watts; and GOST 7842-64 for the positioning and junction dimensions of prongs of vacuum tubes. Efforts toward compatibility with the regulations of the International Electronic Commission are also mentioned. TAB

N66-16263# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
CROWBAR AND POWER CROWBAR SWITCHES AND THEIR CALCULATION [CROWBAR- UND POWER-CROWBAR-SCHALTUNGEN UND IHRE BERECHNUNG]
H. J. Belitz and E. Kugler Brussels, EURATOM, Nov. 1965 54 p In GERMAN; ENGLISH summary
(Contract EURATOM-006-62-10FUAD)
(EUR-2550.d) CFSTI: HC $3.00/MF $0.50

The crowbar is a switching element which makes it possible to control an ignited capacitor discharge by external trigger in such a way that high current impulses of the required form and length are obtained. The two crowbar switches considered

here bring about the transition of the initial discharge state, which is characterized by a rapid current rise, into another dynamic state corresponding to a slow current drop. The tensions and currents in the individual branches of an oscillation circuit with crowbar are calculated and a Fortran digital program is given. Author

N66-16505# Army Engineer Research and Development Labs., Fort Belvoir, Va.
CHARACTERISTICS OF GALLIUM ARSENIDE DIODES AS INFRARED RADIATION SOURCES Interim Report, Nov. 1963–Sep. 1964
Steve B. Gibson and Daniel J. Horowitz Sep. 1965 45 p refs
(Rept.-1831; AD-624129) CFSTI: HC $2.00/MF $0.50

An investigation of the radiating characteristics of gallium arsenide (GaAs) semiconductor infrared sources, both noncoherent and coherent (laser), was made to determine the progress which has been effected in developing them into practical, infrared sources for military night-vision applications. The report concludes that these devices show promise, provided that during further research and development, the present rate of progress is maintained, particularly in the area of efficiency and operation at room temperature. Author (TAB)

N66-16572*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A FAST AND ECONOMICAL TECHNIQUE FOR WELDED CORDWOOD ELECTRONIC MODULE FABRICATION
John C. Sturman Washington, NASA, Feb. 1966 8 p
(NASA-TM-X-1206) CFSTI: HC $1.00/MF $0.50 CSCL 09A

A reliable technique for the fabrication of welded cordwood modules has been developed that is faster and more economical than most other techniques for small quantities or for prototypes. It utilizes a molded plastic preform which retains the components during welding. The preform adds mechanical strength to the unencapsulated circuit and provides a means of centering and holding it in a conventional potting shell. Approved welding and encapsulating techniques may be used to enable the module to be readily flight qualified. Author

N66-16593*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN IMPROVED METHOD FOR MEASURING CURRENT IN HIGH-ENERGY ARC-JET FACILITIES
R. Thomas Hood [1963] 11 p
(NASA-TM-X-57173) CFSTI: HC $1.00/MF $0.50 CSCL 09C

An improved method for measuring current in high energy arc jet facilities using the Hall effect generator was developed. As some arc jet facilities require isolation of 20000 volts, the Hall generator is supported in a Plexiglass (Lucite) chamber filled with transformer oil. The current carrying conductor is passed through the center of the chamber inside a Lucite tube. The generator is positioned near the tube with its plane parallel to and passing through the axis of the conductor. Sensitivity may be adjusted by changing the input voltage or by changing the recording galvanometer. The only disadvantage of the device is its inherent thermal sensitivity. To circumvent this, advantage was taken of the fact that the Hall generator exhibits a negative temperature coefficient when a constant current source is used and a positive temperature coefficient when a constant voltage source is used. If a resistor is inserted in series with the Hall generator excitation circuit, it is possible to arrive at a compromise between the two types of power sources and achieve adequate thermal compensation. R.N.A.

N66-16595*# Westinghouse Electric Corp., Youngwood, Pa. Westinghouse Semiconductor Div.
INTEGRATED POWER AMPLIFIER Final Report, Mar. 1964–Sep. 1965
T. C. New et al [1965] 58 p
(Contract NAS8-11599)
(NASA-CR-70150) CFSTI: HC $3.00/MF $0.50 CSCL 09A

The design and development of an integrated power amplifier consisting of a pair of transistors with associated diodes and resistors encapsulated in an insulated flat package for push-pull amplification operation are presented. The device is intended for space application in power supply systems. Reliability, size and weight, and electrical performance had to be considered. All objectives were achieved. Included are a summary of objectives and results, including a survey of the development and recommendations for further work; a detailed presentation of the amplifier design and development, and a discussion of the encapsulation package. R.N.A.

N66-16614# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
ELECTRON BEAM TECHNIQUES FOR FABRICATION AND ASSEMBLY OF PARTS FOR ELECTRON TUBES Quarterly Report, 1 Apr.–30 Jun. 1965
N. H. Ballard [1965] 26 p refs
(Contract DA-36-039-AMC-03625(E))
(QR-8; AD-625479) CFSTI: HC $2.00/MF $0.50

The time-yield indices of the majority of the 6544 electron beam welding operations have been demonstrated; the results compare favorably with the equivalent indices estimated in Phase II, indicating that the contractual production rate will be complied with. 6914 reproduction tube candidates have been fabricated using tooling and techniques developed during the program. The primary cause of 6914 tube rejection is attributed to contamination which is recognized as a problem common to the photocathode tube industry; steps are being taken to minimize this contamination in pilot line production tubes.
Author (TAB)

N66-16620# Army Electronics Labs., Fort Monmouth, N. J.
FURTHER STUDIES ON HYDROGEN AND DEUTERIUM CLEANUP
Sol Schneider and Norman L. Yeamans Dec. 1965 27 p refs
(ECOM-2639; AD-625389) CFSTI: HC $2.00/MF $0.50

Interest has developed in the use of deuterium as a replacement for hydrogen in thyratrons, clippers, and rectifiers, due to the apparent ability of deuterium to hold off greater voltages than hydrogen under the same conditions. Deuterium also provides a lower arc drop in the gas. At the same time it has the disadvantage of a longer recovery time after a pulse, because of its increased mass. In view of the increasing use of deuterium as a fill gas, a limited experiment to study the transient cleanup phenomena in deuterium was conducted. It was determined that hydrogen and deuterium transient cleanup obey the same fundamental relationship with respect to discharge parameters. In both cases the percentage cleanup under dynamic operating conditions is directly proportional to the square root of the power dissipated in the tube. There were no apparent differences in the solubility factor of the equation. The prime difference in the behavior of both gases was determined to be the difference in diffusion rates. The experimental techniques, the fundamental relationships, the theoretical considerations, the influence of the physical state of the nickel, and the long-term effects are discussed.
Author (TAB)

N66-16626# Northrop Corp., Newbury Park, Calif. Nortronics Applied Research Dept.
STUDY FOR GENERALIZED MODEL FOR SEMICONDUCTOR RADIATION RESPONSE PREDICTION Second Quarterly Progress Report, 15 Mar.–15 Jun. 1965
James P. Raymond and William W. Chang [1965] 72 p refs *Its* Rept.-2
(Contract DA-28-043-AMC-00423(E))
(ECOM-00423-2; AD-625341) CFSTI: HC $3.00/MF $0.75

Investigations included the further study of grown junction diodes and transistors, and the initial study of the transistor element of a monolithic chip integrated circuit. The ionizing radiation response of the diode was calculated using the known values of diode recovery time and junction area. Calculated and observed photocurrents are within a factor of two. The common-emitter response of the grown-junction transistor was calculated. The openbase and small-signal transistor response was obtained from electrical parameter measurement and the collector photocurrent with source resistance of zero. Discrepancies between calculated and observed waveforms are attributed to variations in common-emitter current gain and carrier motion by drift in the collector region. Ionizing radiation effects in an integrated circuit transistor element were studied analytically and experimentally. The lumped model demonstrates the motion of carriers generated in the collector region to the base or substrate regions. The common-emitter response is used to show the influence of the substrate photocurrent on the total observed collector current. Neutron-induced lifetime degradation was directly introduced in the transistor lumped model to give the expected form of transistor gain reduction. The results compare favorably to the Messenger–Spratt prediction.
Author (TAB)

N66-16636 Hughes Aircraft Co., Newport Beach, Calif. Microelectronics Div.
EFFECT OF TRANSISTOR DESIGN PARAMETERS ON RADIATION RESPONSE (SURFACE EFFECTS) Quarterly Report No. 3, 15 Jun.–15 Sep. 1965
Brian D. Gallagher and Vincent R. Honnold Dec. 1965 29 p refs
(Contract DA-28-043-AMC-00418(E))
(ECOM-00418(E)-3; AD-625533) CFSTI: HC $2.00/MF $0.50

Concluding experimental irradiation data were taken on four groups of silicon bars, each containing five samples ranging in thickness between .003 in. and .012 in. The four groups duplicated surface conditions of mechanical polish, etch, sandblast, and oxide processed into the transistor lots tested in the first two quarters. After irradiation, the effective lifetime of each bar was determined. Surface recombination velocity for each surface treatment was then calculated by plotting $1/\tau$ effective minority carrier lifetime as a function of $1/C^2$ where C is the bar thickness. The development of the equations for induced photocurrent for the planar configuration was expanded.
Author (TAB)

N66-16637# Radio Corp. of America, Somerville, N. J. Electronic Components and Devices.
TRANSISTOR, VHF, SILICON, POWER, LINEAR, 30-MC, 100 WATTS PEP Quarterly Progress Report, 1 Jun.–31 Aug. 1965
R. Rosenzweig and D. R. Carley [1965] 59 p *Its* Rept.-1
(Contract DA-28-043-AMC-01387(E))
(QPR-1; AD-625325) CFSTI: HC $3.00/MF $0.75

The report contains information concerning the relationship of device design considerations to device operation in single sideband circuits. The requirement for low intermodulation distortion necessitates class ab biasing, causing the device to operate in a mode where second breakdown and thermal runaway are prevalent. The reduction of second breakdown by the addition of ballast resistors and the use of a temperature compensating diode for bias point control are used to ensure reliable, safe operation. Photomasks have been designed for the 100-watt, 30-megacycle device. The description of the pattern as well as the actual dimensions are given. Author (TAB)

N66-16653# Michigan Univ., Ann Arbor. Electron Physics Lab.
RESEARCH ON CROSSED-FIELD ELECTRON DEVICES Interim Scientific Report No. 6, 15 Mar.–15 Sep. 1965
T. A. De Massa, D. D. Khandelwal, S. G. Lele, N. A. Masnari, K. F. Morman et al Oct. 1965 107 p refs
(Contract DA-36-039-AMC-00027(E))
(Rept.-05361-12-S; AD-625438) CFSTI: HC $4.00/MF $0.75

Pulsed operation of the S-band amplifier using an abbreviated Kino gun resulted in a maximum gain of approximately 20 dB. Attempts at cw operation resulted in large interception of the beam by the slow-wave circuit with the subsequent melting of several fingers of the line, replacement of the circuit by a three-segment planar anode resulted in good dc transmission although spurious oscillations were present over a wide frequency range. Computer calculations of the noise-parameter variations as a function of frequency and position along the beam were carried out for a crossed-field drift region. Experimental investigations with various gun geometries resulted in intrinsic oscillations which could be suppressed by the application of a signal near the cathode. The oscillations appeared to originate in the near-cathode region. A modified aperture system was designed for the investigation of crossed-field electron beams in the beam analyzer. The beam analyzer and associated components are being adapted to allow the investigation of space-charge flows when they are subjected to interaction with an rf wave.
TAB

N66-16654# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION ENGINEERING MEASURE FOR SILICON OVERLAY TRANSISTORS Quarterly Progress Report, 1 Apr.–30 Jun. 1965
Michael Cassidy and Paul Greer Nov. 1965 31 p
(Contract DA-36-039-AMC-06156(E))
(QPR-2; AD-625317) CFSTI: HC $2.00/MF $0.50

Progress during the report period consisted of the following: (1) fabrication of devices using the boron tribromide (BBr_3) base diffusion method. Wafers are also in process using a combination of the BBr_3 base diffusion and the emitter–gold emitter diffusion, (2) transition to 2-inch masks to give better definition and detail, mask measurement by precise methods to insure mask accuracy and repeatability, (3) evaluation of effects of variations in emitter stripe width, (4) fabrication of wafers using the chemical etch process, (5) construction of wafer storager cabinet to determine effects of prolonged wafer storage between various process steps, (6) continued investigation of ultrasonic wire bonding and analysis of the results obtained by ultrasonic bonding to raw kovar top posts, (7) development of a process evaluation test plan and an environmental step stress test plan, completion of initial electrical parameter readouts, evaluation of samples fabricated using the BBr_3 base diffusion method.
Author (TAB)

N66-16674# Lewis (E. B.) Co., Inc., East Hartford, Conn.
PRODUCTION ENGINEERING MEASURE: CRYSTAL UNIT CR-(XM-46A)/U Quarterly Report, 1 Feb.–1 May 1965
Robert P. McComb [1965] 30 p
(Contract DA-36-039-SC-86737)
(QR-9; AD-625202) CFSTI: HC $2.00/MF $0.50

The testing of Preproduction Samples of CR-(XM-46A)/U. AT cut crystals for filter application operating on the third overtone at frequencies of 30 and 45 MC/s is discussed and test procedures given. Author (TAB)

N66-16679# Scientific-Atlanta, Inc., Atlanta, Ga.
TEM DIGITAL FERRITE PHASE SHIFTERS Quarterly Report, 1 Jun.–31 Aug. 1965
J. W. Simon and W. K. Alverson [1965] 80 p refs
(Contract DA-28-043-AMC-01381(E))
(QR-1; AD-625209) CFSTI: HC $3.00/MF $0.75

The results of a literature search covering phase shifter device theory and square-loop ferrite material considerations are presented. Techniques for accurately measuring phase shift of coaxial type devices at microwave frequencies are discussed along with an analysis of maximum possible errors in two such systems. A system is described which uses commercially available components in conjunction with a pair of high performance isolators to obtain very accurate phase measurements. Initial development work on reciprocal TEM latching phase shifters is reported, with detailed discussions of impedance matching problems, radiation effects, and ferrite geometry considerations. Differential phase shifts obtained at C-band are typically 90 degrees per inch, with insertion loss values ranging between 1.0 and 2.0 db for a 180 degree bit. Author (TAB)

N66-16703*# RAND Corp., Santa Monica, Calif.
COMMUNICATION SATELLITE OUTPUT DEVICES
W. F. Feldman Jun. 1965 49 p refs Revised
(Contract NASr-21(02))
(NASA-CR-70037; AD-622418) CFSTI: HC $2.00/MF $0.50 CSCL 09F

Presented are results of a study to investigate the relative ability of semiconductor devices, such as tunnel diodes, transistors, and varactor diodes, and vacuum tube amplifiers such as, triodes, klystrons, amplitrons and TWTs to generate signal power efficiently at frequencies of 1 to 10 kMc and power levels of 0.1 to 100 watts for use as communication satellite output devices. M.R.W.

N66-16723*# Southern Methodist Univ., Dallas, Tex. Thin Films Research Lab.
IMPEDANCE CHARACTERISTICS OF IRRADIATED THIN FILMS Progress Report No. 1, 1 Jun.–1 Dec. 1965
Roy F. Eberline, David S. Glass, and Lorn L. Howard 1 Dec. 1965 37 p refs
(Grant NGR-44-007-006)
(NASA-CR-70017) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Resistant drift and infrared measurements were made on bismuth thin films which were prepared by evaporation. The initial resistance values of the films range from 11 ohms to 395 ohms. Infrared transmission measurements are not yet complete. The measurements are part of an effort to establish that these films are similar to those on which previous impedance characteristics were observed. In addition, a preliminary electron microscope study, both of the structure and of the electron beam irradiation effect, was carried out. These observations tend to indicate that the films and their behavior are similar to those studied earlier. L.S.

N66-16767 Joint Publications Research Service, Washington, D. C.
PULSE FREQUENCY DIVISION WITH PARALLEL CONNECTION OF DIVIDERS
K. M. Sobolevskiy and T. N. Mantyah *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 1–9 ref (See N66-16766 07-14) CFSTI: $6.00

In designing electronic devices, a need often arises for dividing the pulse frequency by large numbers, on the order of 100 or higher. Use is often made of individual dividers with lower scaling ratios which are connected in parallel when the output pulses of each of the dividers are applied to an AND circuit. The overall scaling factor of the parallel circuit depends on the relationship of the scaling factors of the individual dividers. A theoretical analysis is made of certain general questions concerning the selection of the frequencies and the scaling factors of the dividers connected in parallel. R.N.A.

N66-16768 Joint Publications Research Service, Washington, D. C.
ANALYSIS OF THE OPERATION OF A PARAMETRIC PULSE AMPLITUDE MODULATOR
Sh. Yu. Ismailov, L. P. Korichnev, and G. I. Nechayev *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 10–15 refs (See N66-16766 07-14) CFSTI: $6.00

This paper considers a pulse-amplitude modulator having amplifying properties; an analysis is presented of a circuit with large controlling signals which permits most effective use of the properties of the electron-hole transition. Author

N66-16769 Joint Publications Research Service, Washington, D. C.
MEASUREMENT OF QUALITY OF CIRCUITS WITH NONLINEAR INDUCTANCE
N. G. Kharatishvili *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 16–19 refs (See N66-16766 07-14) CFSTI: $6.00

This paper describes an attachment for a two-beam oscilloscope for the recording of the curves of the variation of the quality of circuits with ferrite cores as a function of the amplitude of the signals. Author

N66-16771 Joint Publications Research Service, Washington, D. C.
CURRENT AND VOLTAGE METERING TRANSFORMER
V. F. Sidyakin *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 26–28 (See N66-16766 07-14) CFSTI: $6.00

The design of a current and voltage metering transformer which reduces both current and voltage losses to less than 1.5% at a frequency of 50 cps is discussed. R.N.A.

N66-16780 Joint Publications Research Service, Washington, D. C.
STABILITY OF MOTION OF RECEIVER ROTOR OF SYNCHRONOUS SERVO SYSTEM WITH TWO DEGREES OF FREEDOM
Ye. M. Karpov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 80–86 refs (See N66-16766 07-14) CFSTI: $6.00

This paper presents a detailed derivation of the conditions for the stability of the motion of the moving part of the receiver, analyzes the results obtained, and presents the curves for the transient processes for various stability conditions.
Author

N66-16783 Joint Publications Research Service, Washington, D. C.
CONVERTER OF ELECTRICAL VOLTAGE TO SHAFT ANGLE ROTATION AND DIGITAL CODE
M. N. Glazov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 96–101 refs (See N66-16766 07-14) CFSTI: $6.00

This paper describes an electromechanical converter of dc electrical voltage into shaft angle rotation and digital code which is constructed on the basis of a servo system with stepper motor. The electrical circuit and the basic characteristics of the instrument are presented.
Author

N66-16910 Westinghouse Electric Corp., Youngwood, Pa.
STATE-OF-THE-ART IN HIGH POWER SILICON CONTROLLED RECTIFIER THYRISTORS
T. C. New and T. P. Nowalk *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 788–796 (See N66-16826 07-23) CFSTI: $8.50

The basic characteristics of the thyristor are summarized and the state-of-the-art capabilities and limitations of the thyristor are reviewed. Also, trade-offs required in device design which can be made and are necessary to optimize the overall device function are discussed and two cases are reviewed for the application of these devices to demonstrate how the thyristor has been used in large numbers for parallel or series operations and how their characteristics can be tailored to some degree for maximum benefit to the user. Finally, a certain magnet power supply requirement is illustrated. It is noted that the present state-of-the-art of thyristors is well developed to handle not only high power rectifier characteristics but the demanding switching characteristics for a wide range of applications. Also, the use of such devices for magnet control is not only feasible but desirable based on durability and reliability performance.
E.E.B.

N66-16911 Midwestern Universities Research Association, Stoughton, Wis.
AN ADJUSTABLE CURRENT SHUNT FOR TRIMMING THE AMPERE TURNS IN A MAGNET OPERATING FROM A CONSTANT dc SOURCE
John W. Hicks *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 797–807 refs (See N66-16826 07-23) CFSTI: $8.50

A simple practical method for maintaining the current division between a coil and a shunt in the kilowatt power range has been developed. The design equations are presented with their sample calculations. Factors considered for obtaining ±5% adjustability, while maintaining ±0.01% stability of field coil ampere turns, are field coils turns and resistance, temperature and pressure of the cooling supply, and effects of the thermocouple junctions. Experimental and calculated performances are compared for various operating conditions.
Author

N66-16912 Argonne National Lab., Ill.
RECTIFIER POWER SUPPLIES FOR ZGS EXPERIMENTAL MAGNETS
Jan Rijk *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 808–816 (See N66-16826 07-23) CFSTI: $8.50

A number of rectifier power supplies are used at the ZGS experimental areas to power the various beam bending and focusing magnets. The power supplies are portable and can be operated from a remote position. Each power supply has its own protective equipment and failure annunciator. Magnetic amplifiers or silicon controlled rectifiers are used for control and regulation. The power supplies are regulated to a high degree of stability and may be used either in a current regulation mode or in a voltage regulation mode. The different power supplies may be operated in series, parallel and series-parallel combinations.
Author

N66-16913 Princeton-Pennsylvania Accelerator, Princeton, N. J.
PRINCETON-PENNSYLVANIA ACCELERATOR STANDARD MAGNET CURRENT REGULATORS
J. Riedel *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 817–822 refs (See N66-16826 07-23) CFSTI: $8.50

The 2nd harmonic current transducer which is unique with the Princeton-Pennsylvania accelerator regulators is discussed. Also, the complete regulator circuit is shown in block diagram form. The operational amplifier has a dc gain of 3×10^5 and unity gain at one megacycle. The measured typical voltage drift, referred to input, is 10 to 50 μv peak to peak. The input current drift is 5 to 25 naptp and the input impedance is greater than 10^6 ohms. The mag amp driver can deliver ±3 amps into a 7 ohm load. All transistors are silicon and printed circuits are used wherever possible. The principle virtue of these regulators is their reliability. On the basis of measurements made on the individual components and in the open loop gain, the accuracy of current measurements is estimated to be at least 0.01%. A check against a shunt signal showed a stability of better than 0.002% over a seven day period. Over longer periods the stability is considered to be at least 0.01%.
E.E.B.

N66-16985*# Battelle Memorial Inst., Columbus, Ohio.
A STUDY OF THE RELIABILITY OF ELECTRONIC COMPONENTS IN A NUCLEAR-RADIATION ENVIRONMENT Twelfth Quarterly Report, Oct. 1–Dec. 31, 1965
C. L. Hanks and D. J. Hamman 13 Jan. 1966 14 p Prepared for JPL
(Contracts NAS7-100; JPL-950458)
(NASA-CR-70172) CFSTI: HC $1.00/MF $0.50 CSCL 09A

The 8000 hour parameter measurements on all capacitors, transistors, and diodes in the seven test groups were completed, and the 9000 hour measurements were begun. The components in test groups III, V, and VI have now accumulated a total of 9150 hours of nuclear irradiation. Total neutron and gamma exposure at 8000 hours is given for these same three groups. Group V has received 6.2×10^{12} n/cm^2 and 8.35×10^8 ergs/g; groups III and VI have received 7.3×10^{12} n/cm^2 and 8.30×10^8 ergs/g. All component failures which have occurred since 7000 hours are listed along with their respective causes.
D.T.

N66-16987# International Resistance Co., Philadelphia, Pa. Documented Reliability Div.
PRODUCTION ENGINEERING MEASURES FOR HIGH RELIABILITY, FIXED, FILM, PRECISION RESISTORS Quarterly Progress Report, 1 Jul.–30 Sep. 1965
Richard C. Wagner [1965] 14 p
(Contract DA-36-039-AMC-01461(E))
(QPR-11; AD-624436) CFSTI: HC $1.00/MF $0.50

RNR57, RNR55 and RNR65 pilot run pieces are being processed utilizing the automatic equipment designed and built as

part of the program. The original RNR60 pilot run pieces were discarded after it was discovered that the cap termination contact was below standard. Corrective action was taken and the pieces are being remade. Author (TAB)

N66-16995# Cornell-Dubilier Electronics Div., Federal Pacific Electric Co., Norwood, Mass.
PRODUCTION ENGINEERING MEASURE FOR CAPACITORS FEED-THROUGH, SOLID ELECTROLYTE TANTALUM PELLET Quarterly Report, 1 Jul.–30 Sep. 1965
W. G. Bailey [1965] 40 p refs
(Contract DA-36-039-AMC-03630(E))
(OR-6; AD-624513) CFSTI: HC $2.00/MF $0.50

Low impedance aging of 1000 hours minimum was completed on Lot E preproduction samples. The yield (based on 200 anode starts) was 80%. Quality Control started qualification testing, per Table VI of SCL-6423, except that the life test was to be conducted directly off of lead-acid storage batteries. Group I, II, and III tests have been completed and there are no failures. Group II testing is in process. Group V, testing (Life Test) experienced an overheating of the life test oven due to a faulty thermostat at the 532-3/4 hour point. Five shorted units were removed, the oven repaired and the test continued. To the end of this quarter, the life test has completed 1257 hours with no failures at 85° C and 35 VDC. The life test is continuing. All preproduction testing will be completed in the next quarter. TAB

N66-17064# Radio Corp. of America, Harrison, N. J. Microwave Tube Operations Dept.
A LOW-NOISE, MULTIPLE-FUNCTION, X-BAND TRAVELING-WAVE TUBE Interim Development Report, 1 Apr.–30 Jun. 1965
M. Milden [1965] 20 p
(Contract NObsr-87535)
(IDR-11; AD-624411) CFSTI: HC $1.00/MF $0.50

Work was done during the quarter on six items: the electron gun, focusing, the helix, the video section, tube VSWR, and the capsule. The overdrive performance in the linear section was improved by moving the attenuator toward the input, but further improvement in the limiter section is necessary. The use of tapered helices is contemplated. The helix design is capable of providing the necessary gain and bandwidth within the length specified for the tube. It was shown that the rf coaxial window assemblies can provide a VSWR of less than 1.3 to 1 from 7.0 to 11.0 Gc. The ppm focusing structure is adequate from both the beam-transmission and noise figure aspects. The video section is mechanically sound but needs improvement in the processing of the dynodes. Author (TAB)

N66-17078*# Preston Scientific, Inc., Anaheim, Calif.
CAPACITOR SCREENING EVALUATION TEST PROGRAM Final Report
Stanley W. Abe 17 Nov. 1965 79 p Prepared for JPL
(Contracts NAS7-100; JPL-950864)
(NASA-CR-70303) CFSTI: HC $3.00/MF $0.75 CSCL 09A

A screening evaluation test program was conducted to evaluate the effects of screening on fixed ceramic dielectric low voltage capacitors by supplying failure data and parameter degradation data. Two groups (screened and unscreened) were subjected to a 10000 hour life test with periodic measurements of critical capacitor parameters. These parameters being capacitance, dissipation factor, and insulation resistance. Statistical comparisons between the groups were made based on the periodic measurements to reveal differences in their parametric behavior. Among the conclusions are that no catastrophic or parametric failures occurred, there was a definite overall downward drift in all three parameters from initial to 10000 hours, and that the capacitors reacted significantly to the first 50 hour temperature burst and again at the 500 hour point in the life test. C.T.C.

N66-17104*# Battelle Memorial Inst., Columbus, Ohio.
A STUDY OF THE RELIABILITY OF ELECTRONIC COMPONENTS IN A NUCLEAR-RADIATION ENVIRONMENT Eleventh Quarterly Report, Jul. 1–Sep. 30, 1965
C. L. Hanks and D. J. Hamman 15 Oct. 1965 14 p Prepared for JPL
(Contracts NAS7-100; JPL-950458)
(NASA-CR-68841) CFSTI: HC $1.00/MF $0.50 CSCL 09A

It is reported that life tests on electronic components subjected to a nuclear radiation environment were continued. These components include capacitors, diodes, controlled rectifiers, and transistors. Tables are given of component parts which have indicated failure, approximate neutron and gamma exposures with irradiation periods of up to 7000 hours, and components indicating catastrophic failure. C.T.C.

N66-17108*# CBS Labs., Stamford, Conn.
ONE YEAR LIFE TEST OF 1-1/2 INCH IMAGE DISSECTOR Final Report
J. Z. Karpinski 13 Dec. 1965 19 p Prepared for JPL
(Contracts NAS7-100; JPL-950054)
(NASA-CR-70334) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Two image dissectors, of the type used in the Mariner IV Mars probe were continuously operated in laboratory life test equipment for a period of one year. The test was devised to simulate the loading conditions which occur with the tube in an operation mode. The general test condition specifications are outlined, and voltage measurements made before and after the years life test are tabulated. Curves for each tube are given, showing the variations in anode signal and dark currents which occurred during the test. A circuit diagram of the life test unit is given. Evaluation of the results indicate the ability of the CL1228 image dissector tubes to operate continuously for one year under simulated application conditions. The small changes in performance characteristics observed, indicate that this type of tube is highly suitable for extended space missions. L.S.

N66-17110*# CBS Labs., Stamford, Conn.
SHORT WIDE ANGLE, 1-1/2 INCH ELECTROSTATIC IMAGE DISSECTOR WITH PARALLEL PLATE RESISTIVE STRIP ELECTRONIC MULTIPLIER Final Report, 22 Feb. 1963–1 Nov. 1965
J. Z. Karpinski 1 Dec. 1965 73 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950508)
(NASA-CR-70338) CFSTI: HC $3.00/MF $0.75 CSCL 09A

An integrated anode/deflection cone, and an electron optical imaging system were developed for a short wide angle 1 1/2 in. electroetatic image dissector with a parallel plate resistive strip electron multiplier and an integrated drift free anode/deflection system. Thirteen tubes incorporating the integrated anode/deflection cone, a focus electrode, and a modified faceplate mounting were fabricated. The tubes were exhaust and leak tested; and the deflection plate and aperture were aligned, and evaluated by drift tests. The test results indicate that significant advances were made in the tube design and processing. L.S.

N66-17115# Applied Physics Lab., John Hopkins Univ., Silver Spring, Md.
MICROELECTRONIC ENGINEERING. VOLUME I: FABRICATION TECHNOLOGY
William Liben, ed. 1965 356 p refs
(Contract NOw-62-0604-c)
(NAVWEPS-16-1-533; AD-624315) CFSTI: HC $7.00/MF $1.75

This text will prepare the designer to design systems which can be fabricated using the presently available technology, and to follow the technical literature and thus keep abreast of the art as it develops. The first chapter places in perspective the field of Microelectronics and presents a highly simplified picture of the Microelectronics fabrication processes. This brief description will establish a framework for understanding the detailed material to be presented. The rest of the material is divided into a series of chapters on: (1) Solid state theory, designed to provide an adequate understanding of the behaviour of the devices used; (2) Fabrication technology of both the thin film and semiconductor microelectronic circuits. TAB

N66-17116# Litton Systems, Inc., Waltham, Mass.
MICROELECTRONIC POWER SUPPLIES Final Phase Report
F. G. Benhard Johnsville, Pa., Naval Air Develop. Center, 16 Nov. 1965 81 p
(Contract NOw-63-0749-di)
(NADC-AE-6520; AD-624838) CFSTI: HC $3.00/MF $0.75

The objectives of the program represent an attempt by a governmental agency to develop standard power supplies electrically and mechanically compatible with state-of-the-art microelectronic systems, with particular emphasis on reliability improvement, weight reduction, and maximum possible use of microelectronic devices. The developmental model power supplies as finally submitted to the Navy demonstrated performance characteristics well within the final acceptance criteria. Author (TAB)

N66-17117# Systems, Inc., Orlando, Fla.
PEM FOR FILTER, QUARTZ CRYSTAL, 112 MC, TYPE EL-FR (X-2) AND CRYSTAL UNIT, FILTER, QUARTZ TYPES CR-(XM-64)/U AND CR-(XM-65)/U Second Quarterly Progress Report, 1 Feb.–30 Apr. 1965
[1965] 30 p refs
(Contract DA-36-039-AMC-03638(E))
(AD-624642) CFSTI: HC $2.00/MF $0.50

Preliminary crystal designs and test results are discussed. The response characteristics of a breadboard filter using the preliminary crystal design is described. The completion of test equipment fabrication is reported. Author (TAB)

N66-17124# Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR MECHANIZATION OF HIGH-RELIABILITY CAPACITORS Quarterly Report, Jun. 30–Sep. 30, 1965
P. M. Kennedy and G. E. Walters [1965] 12 p
(Contract DA-36-039-AMC-01460(E))
(QR-11; AD-624515) CFSTI: HC $1.00/MF $0.50

Work during this period consisted primarily of modification and adjustment to existing parts of the machines in order to optimize their efficiency. The nature of these modifications is described herein. Author (TAB)

N66-17232*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENCAPSULATION, ELECTRONICS, ECCOFOAM
Francis N. Le Doux Nov. 1965 38 p
(NASA-TM-X-55394; X-723-65-450) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Details and handling instructions are given on the preparation and use of a polyurethane foam, Eccofoam, as an encapsulant and a means of structural reinforcement for electronic components and associated wiring. Details and instructions also are given on the preparation and use of a casting resin, Stylcast-Locktite, as a sealant. Parameters for construction of molds; proper curing temperatures; relative amounts of resin and catalyst necessary to achieve a desired density; length of drying times; preparation of components and joints; and environmental extremes which the materials can withstand are included. D.T.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N66-16417*# Case Inst. of Tech., Cleveland, Ohio. Engineering Design Center.
A PROGRAMMABLE DIGITAL COMPENSATOR FOR SINGLE LOOP HIGH PERFORMANCE DIGITAL SERVOMECHANISMS
Donald J. Gawlowicz 1965 236 p refs
(Grant NsG-36-60)
(NASA-CR-69868; EDC-7-65-30) CSCL 09C

The purpose of this research was to investigate the feasibility of designing a programmable digital compensator of sufficiently low cost to be employed in a single high performance control loop with virtually any analog dynamics in the frequency range of interest. A compensator with a cost comparable to that of components presently used in high performance servomechanisms was designed and built. The machine was wired to solve linear, constant coefficient, difference equations. The output of the machine is therefore a weighted sum of past inputs and outputs of the machine. The inputs and outputs are stored in a magnetostrictive delay line which is clocked at one megacycle. The desired program is selected by inserting the appropriate weighting constants into a programmable diode matrix. Up to fifteen past inputs and outputs may be used in the program. The time between input samples may also be programmed within reasonable limits. Author

N66-16468# Lincoln Lab., Mass. Inst. of Tech., Lexington.
GENERAL RESEARCH Quarterly Technical Summary Report, 1 May–31 Jul. 1965
Frederick C. Frick et al 1 Nov. 1965 59 p refs
(Contract AF 19(628)-5167)
(ESD-TDR-65-316; AD-623651) CFSTI: HC $3.00/MF $0.75

The summary consolidates the reports of Division 2 (Data Systems), Division 3 (Radio Physics), Division 4 (Radar), Division 7 (Engineering), and Division 8 (Solid State) on the General Research Program at Lincoln Laboratory. Author (TAB)

N66-16596*# Michigan Univ., Ann Arbor.
THE NECESSARY CONDITIONS FOR AMPLIFICATION OF AN ELECTROMAGNETIC WAVE INTERACTING WITH A DRIFTING ELECTRON STREAM Technical Report No. 88
H. C. Hsieh and J. E. Rowe Nov. 1965 68 p refs Its Rept.-06621-4-T
(Grant NsG-696)
(NASA-CR-70143) CFSTI: HC $3.00/MF $0.75 CSCL 09C

On the basis of a one-dimensional, small-signal, single-velocity beam theory, the forbidden and permitted regions of wave amplification are determined in terms of the system parameter space (B,Ω,g) by examining the real roots of the determinantal equation for a beamwave system in which the wave is propagated along a lossless circuit. The system parameters are defined as $B=v_b/u_o$. $\Omega=B(\omega_p/\omega)$ and $g=B(Z_c I_o/2V_o)$, with v_o and u_o being the phase velocity of the unperturbed circuit wave and the initial average electron-beam velocity, respectively; ω_p and ω are the electron-beam plasma frequency and the angular frequency of the electromagnetic wave, respectively; Z_c is the coupling impedance; I is the d-c beam current; and V_o is the dc beam voltage. The necessary conditions for wave amplification are obtained for forward- and backward-wave interaction without imposing any restriction upon the system parameters. It is shown that wave amplification is possible under rather general circumstances. Furthermore, at synchronism for $g<1$ it is observed that there are two ranges of values of $\Omega_o=(\omega_p/\omega)$ over which wave amplification is possible. In the first range it is the forward-propagating wave that is amplified, whereas in the second range it is the backward-propagating wave which is amplified. Author

N66-16608# New York Univ., N. Y. Lab. for Electroscience Research.
STEADY-STATE AND TRANSIENT RESPONSE OF ARBITRARY TAPERED DISTRIBUTED RC NETWORKS WITH LUMPED LOAD TERMINATIONS SCIENTIFIC REPORT NO. 22
John L. Kelly and Mohammed S. Ghausi Oct. 1965 25 p refs *Its* Tech. Rept.-400-120 Presented at Natl. Electron. Conf., 25 Oct. 1965
(Contract AF19(628)-379)
(AFCRL-65-803; AD-625392) CFSTI: HC $1.00/MF $0.50

The network properties of arbitrary tapered distributed RC networks are obtained in series and product forms using techniques based on the work of Carson and Rayleigh. The network functions so obtained are readily interpreted using pole-zero patterns and the equivalent dominant pole-zero viewpoint. Steady-state frequency response and transient response of terminated distributed RC twoports are shown to be easily obtained using the equivalent dominant pole and excess phase approximation. The approach is applicable to tapered networks terminated in lumped or distributed loads. Author

N66-16706*# Auburn Research Foundation, Inc., Ala. Servomechanisms Lab.
THE X-TRANSFORM AND ITS USE IN SAMPLED DATA SYSTEM ANALYSIS Second Technical Report
28 Jun. 1965 166 p refs
(Contract NAS8-11116)
(NASA-CR-70031) CFSTI: HC $5.00/MF $1.00 CSCL 09C

A general theory for a transform, called the x-transform, is developed for use in analyzing a special class of sampled-data systems. The x-transform is applicable to sampled-data systems which have all samplers followed by zero-order hold devices. Stability criteria for open-loop and closed-loop sampled-data control systems are investigated. The application of the x-transform method of analysis to other various sampled-data systems is also investigated. L.S.

N66-16765# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
ON THE MEASUREMENT OF RANDOMLY TIME-VARYING LINEAR SYSTEMS
Gerald E. Pollon May 1965 76 p refs
(Contract NOw-61-0400)
(ESL-R-238; AD-624693) CFSTI: HC $3.00/MF $0.75

It is shown what measurements to perform on a system that is randomly time-varying and linear, but otherwise unknown, to completely characterize it. The success of these measurements depends on a representation of a randomly time-varying linear system different from those commonly used. It is shown what measurements to perform on a randomly time-varying linear system to predict the auto-correlation function of the output signal from the auto-correlation function of the input signal when the input is a stationary random process. It is shown what measurements must be performed on a randomly time-varying linear system to design a linear open-loop controller which is optimum in the mean square sense. These measurements are simpler than the measurement of the auto-correlation function transfer relation. Experimental results concerning measurement and system performance were accomplished by applying a white Gaussian test signal to the unknown system and measuring statistical averages of quantities obtained by jointly manipulating the input and resulting output. Author (TAB)

N66-16770 Joint Publications Research Service, Washington, D. C.
METHODS FOR MEASUREMENT OF PASSBAND OF RESONANT SYSTEMS
L. P. Kornev and A. A. Krivetskiy *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 20-25 refs (See N66-16766 07-14) CFSTI: $6.00

The present paper considers a method for tuning multiloop resonant systems to a specified effective passband by the method of comparison with a reference single-loop system with respect to reaction to a short pulse-type excitation. A description is given of the block diagram of an electronic meter with a pointer indicator for the magnitude of the effective frequency passband. Author

N66-16776 Joint Publications Research Service, Washington, D. C.
OPTIMAL TRANSIENT PROCESS IN LINEAR SYSTEMS WITH RATIONAL FRACTION TRANSFER FUNCTIONS
D. I. Likerman *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 55-61 refs (See N66-16766 07-14) CFSTI: $6.00

This paper considers the questions of optimal control of linear systems with transfer functions of the form $K(p)=B(p)/A(p)$. The problem of finding the optimal control is resolved with the aid of the maximum principle and coordinate conversion. Author

N66-16777 Joint Publications Research Service, Washington, D. C.
ANALYSIS OF NONLINEAR INSTRUMENT SERVO SYSTEMS
L. P. Smol'nikov and V. A. Khokhlov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 62-65 ref (See N66-16766 07-14) CFSTI: $6.00

Using as an example a typical nonlinear instrument servo system this paper presents a method of construction of the performance diagram for the damping of the nonlinear oscillations which is based on a combination of the harmonic linearization method and the root methods. Author

N66-16778 Joint Publications Research Service, Washington, D. C.
STRUCTURE OF FREQUENCY FILTERS FOR ADAPTIVE CIRCUITS
V. I. Kostyuk *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 66–72 refs (See N66-16766 07-14) CFSTI: $6.00

Consideration is given to the selection of the structure of frequency filters in an adaptive circuit. Results are presented from the modeling of adaptive servo systems with optimal frequency filters on an analog computer. Author

N66-16779 Joint Publications Research Service, Washington, D. C.
DIGITAL REPRODUCTION OF QUANTITIES EXPRESSED BY A LINEAR FREQUENCY SIGNAL
N. N. Atamanenko *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 73–79 refs (See N66-16766 07-14) CFSTI: $6.00

This article examines the questions of the digital reproduction of a controlled quantity expressed by a linear frequency signal with the aid of a counter cyclometer circuit with input divider. An estimate is made of the loss of accuracy with transfer to a deviation scale for the primary forms of receiver tuning. Ways are pointed out for obtaining a specified accuracy with transfer to reproduction of the deviations. Author

N66-16781 Joint Publications Research Service, Washington, D. C.
PRINCIPLES OF COMBINING OPERATIONAL AND LONG-TERM MEMORIES
N. S. Anishin and G. G. Rekus *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 87–91 (See N66-16766 07-14) CFSTI: $6.00

This paper considers the basic principles of combining operational and long time memories, and their application for various ferrite memory systems to improve reliability and reduce the amount of equipment, size, and weight. R.N.A.

N66-16782 Joint Publications Research Service, Washington, D. C.
CAPACITIVE PENTASTABLE PARAMETRON
Yu. N. Yefimov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 92–95 refs (See N66-16766 07-14) CFSTI: $6.00

This paper presents equations for computing the stationary regime of the capacitance parametron based on equation analogies of the inductive and capacitive parametrons. To obtain pentastability in the capacitive parametron use is made of nonlinear capacitors with symmetric voltage charge characteristics, which in the case of diodes is achieved by connecting them head-on. R.N.A.

N66-16784 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF PERMISSIBLE AMBIENT TEMPERATURE VARIATION AND SUPPLY VOLTAGE RANGES FOR STABLE OPERATION OF FERROTRANSISTOR CELLS (FTC)
V. S. Kuznetsov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 102–110 refs (See N66-16766 07-14) CFSTI: $6.00

This paper presents a method for determining the permissible ambient temperature variations and supply voltage ranges for the stable operation of ferrite transistor cells. R.N.A.

N66-16785 Joint Publications Research Service, Washington, D. C.
A METHOD OF SYNTHESIS OF MAJORITY CIRCUITS
L. Ya. Rozenblyum *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 111–116 refs (See N66-16766 07-14) CFSTI: $6.00

This article presents a method of synthesis of circuits from majority elements which realize monotone functions by means of sequential exclusion of variables. It is shown that on the basis of this method there can be obtained a universal decomposition with fixation of the variables which is valid for any logic functions. Author

N66-16791 Joint Publications Research Service, Washington, D. C.
MULTIELEMENT DYNAMOMETRIC SENSOR WITH HELICAL TRANSFORMERS
A. S. Radchik *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 146–152 refs (See N66-16766 07-14) CFSTI: $6.00

A description and analysis is presented of a dynamometric sensor with helical transformers which consists of a set of elastic elements and which provides high sensitivity and a linear relationship with small loads. Author

N66-16800# Joint Publications Research Service, Washington, D. C.
STUDIES IN MULTIPOLES AND MULTIPLY-CONNECTED PULSE SYSTEMS
20 Jan. 1966 19 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 165, no. 1, 1965 p 47–54 (JPRS-33817; TT-66-30260) CFSTI: $1.00

CONTENTS:

1. MULTIPOLES CONTAINING CLOSING CONTACTS OF INTERNAL RELAYS A. G. Lunts p 1–7 refs (See N66-16801 07-10)

2. TEST FOR ABSOLUTE STABILITY OF MULTIPLY-CONNECTED PULSE SYSTEMS WITH NONSTATIONARY CHARACTERISTICS OF NONLINEAR ELEMENTS Ya. Z. Tsypkin and M. S. Epel'man p 8–13 refs (See N66-16802 07-10)

N66-16801 Joint Publications Research Service, Washington, D. C.
MULTIPOLES CONTAINING CLOSING CONTACTS OF INTERNAL RELAYS
A. G. Lunts *In its* Studies in Multipoles and Multiply-Connected Pulse Systems 20 Jan. 1966 p 1–7 refs (See N66-16800 07-10) CFSTI: $1.00

This paper generalized the method of characteristic functions of valve-contact multipoles to the case in which the multipole, in addition to valves and contacts of external relays (relays independent of the circuit), contains closing contacts of internal relays. The existence of feedback produces a transition process. Since the circuit has no switching-out contacts for the internal relays, the transient process stabilizes after a finite time interval that depends on the operating time of the internal relays, and the circuit assumes a stable state, which can be removed only by an external action. The stable state depends solely on the state of the external relays and on the potentials fed to the poles, and is independent of the operating time of the internal relays. Multipoles for which the indicated relations hold are called equivalents. Every transformation of a multipole into an equivalent multipole can be accomplished by algebraic transformation of its characteristic form. R.N.A.

N66-16802 Joint Publications Research Service, Washington, D. C.
TEST FOR ABSOLUTE STABILITY OF MULTIPLY-CONNECTED PULSE SYSTEMS WITH NONSTATIONARY CHARACTERISTICS OF NONLINEAR ELEMENTS
Ya. Z. Tsypkin and M. S. Epel'man *In its* Studies in Multipoles and Multiply-Connected Pulse Systems 20 Jan. 1966 p 8–13 refs (See N66-16800 07-10) CFSTI: $1.00

The formulation and proof of a theorem are presented for testing the absolute stability of a multiply-connected pulse system containing a complex linear continuous part, M synchrophase pulse elements, and M nonlinear elements which have time dependent characteristics. R.N.A.

N66-16909 Spectromagnetic Industries, Inc., Hayward, Calif.
STATE OF THE ART FOR PRECISION CURRENT OF FIELD REGULATED POWER SUPPLIES
Fred W. Kruse, Jr. *In* Stanford Univ. Proc. of the Intern. Symp. On Magnet Technol. 1965 p 779–787 refs (See N66-16826 07-23) CFSTI: $6.50

A number of high performance solid state components have been developed for precision current of magnetic field regulated power supplies. These components have been combined to meet specifications for current regulation, stability, and ripple; and have resulted in improved field regulated power supplies. Better devices and techniques have improved reference sources, current shunts, control amplifiers, power control elements, and Hall field sensors, all of which are now used in commercially-available supplies. Application of these techniques has significantly reduced cost of precision magnet power supplies. Design of a typical power supply is discussed under the headings of control amplifier and reference, current sensing shunt, series passing element, water resistivity, optimum load resistance, pre-regulator, and magnetic field sensing. Test methods for performance verification are also considered. M.W.R.

N66-16917# Martin Co., Orlando, Fla.
THE SYMBOLIC INTEGRATED MAINTENANCE SYSTEM (SIMS) APPROACH TO TECHNICAL DATA ANALYSIS AND COMMUNICATION
R. Lombardi and R. P. Eldredge Apr. 1965 48 p ref
(OR-6459)

An evaluation was made of a symbolic integrated maintenance system with the primary concern of improving technical data communications. The history of the system is presented, its effect on technical data analysis and communications is discussed, and its many possibilities as a valuable design analysis and documentation tool are described. C.L.W.

N66-16961# Case Inst. of Tech., Cleveland, Ohio. Systems Theory Group.
CONCERNING AN ALGEBRAIC THEORY OF SYSTEMS
Thomas G. Windeknecht [1965] 35 p refs
(Contract Nonr-1141(12))
(SRC-78-A-65-30; AD-623723 CFSTI: HC $2.00/MF $0.50

There exists a definite trend in engineering to undertake the design and study of systems of increasing size and complexity. In this, there are encountered practical difficulties which suggest the need for a mathematical theory of systems possessing considerably greater generality and conceptual power than existing theories. It appears that such a general, unified theory of systems can be developed along definite algebraic lines. This is so because essentially all of the mathematical models being used for the study of systems of various kinds have a common abstract structure. The purpose of the presentation is to display this abstract structure in terms of an algebraic formalism, and to discuss the applicability of such theory as is developed around it. In particular, it is demonstrated that the proposed theory unifies and, through axiomatic development, subsumes automata theory, the theory of Turing machines, and the input-output theory of systems defined by sets of differential equations and difference equations.
Author (TAB)

N66-16980*# Villanova Univ., Pa.
A BIBLIOGRAPHY ON DIGITAL COMPUTER-AIDED CIRCUIT ANALYSIS AND DESIGN
Tsute Yang [1965] 28 p refs
(Grant NGR-39-023-004)
(NASA-CR-70211) CFSTI: HC $2.00/MF $0.50 CSCL 09C

This bibliography lists pertinent literature on computer-aided techniques and programs directly connected with circuit analysis and design. The entries are arranged in the alphabetic order of the last name of the first author of each paper. A subject index and a chronological index are appended. Author

N66-17002# RAND Corp., Santa Monica, Calif.
A PROBLEM EMANATING FROM A STUDY OF FEEDBACK LOOPS IN STOCHASTIC NETWORKS
Paul Brock and Stephen Drezner Dec. 1965 9 p refs
(P-3276; AD-624817) CFSTI: HC $1.00/MF $0.50

A closed expression is developed for an equation giving the number of distinguishable ways of going around loop L_k k times provided that an external return is made to the starting node r times. TAB

N66-17023# Naval Research Lab., Washington, D. C.
THE ROLE OF INDUCTANCE IN SUPERCONDUCTING ENERGY STORAGE CIRCUITS
D. J. Hanrahan Oct. 1965 11 p refs
(NRL-MR-1658; AD-624707) CFSTI: HC $1.00/MF $0.50

The zero-resistance property of superconducting circuits makes inductance a decisive parameter. The performance of a superconductor energy storage system is marred by the presence of inductance in either the superconducting switch or the load. Both kinds of inductance result in an energy loss. The superconducting switch should be made non-inductive, but the normal resistance of the switch also causes an energy loss. The effects of both load inductance and finite switch resistance may be minimized by a current-step-down output transformer.
Author (TAB)

N66-17039# George Washington Univ., Washington, D. C. Center for Measurement Science.
ON THE STABILITY AND DYNAMIC BEHAVIOR OF CASCADED THERMOELECTRIC DEVICES
D. K. Anand, Morton F. Taragin, and Louis de Pian 30 Oct. 1965 7 p refs Submitted for Publication
(Contract Nonr-761(09))
(Rept.-4; AD-624828) CFSTI: HC $1.00/MF $0.50

The dynamic response of single-stage thermoelectric devices and the static behavior of single-stage and thermally cascaded devices have been studied by many researchers. However, little work has been done on the dynamic response of cascaded devices. The effect is shown of cascading on stability and dynamic response by analyzing the small signal transfer functions. TAB

N66-17223*# Brown Univ., Providence, R. I.
ON THE EXISTENCE OF LIAPUNOV FUNCTIONS FOR THE PROBLEM OF LURIE
K. R. Meyer [1964] 25 p refs Submitted for Publication (Grants NGR-40-002-015; AF-AFOSR-693-64; Contract DA-31-124-ARO(D)-270)
(NASA-CR-60170) CFSTI: HC $1.00/MF $0.50 CSCL 09C

Presented is an extension of the work of Yacubovich and Kalman on the existence of Liapunov functions for the problem of Lurie. The primary result is the removal of the unnecessary hypothesis of complete controllability and complete observability from the theorem of Kalman. Several applications of the lemmas developed are included. E.E.B.

N66-17224*# Brown Univ., Providence, R. I.
ON STABILITY IN CONTROL SYSTEMS
Emilio Roxin [1964] 30 p refs Submitted for Publication (Grants NGR-40-002-015; AF-AFOSR-693-64)
(NASA-CR-60377) CFSTI: HC $2.00/MF $0.50 CSCL 09C

An axiomatic foundation of the theory of control systems was previously developed based upon the notion of attainable sets. Starting from a set of basic axioms, it was shown that the properties of the so defined systems are in accordance with those of commonly known control systems. The main advantage of this approach lies in the fact that concepts like invariance, recurrence, stability, etc., are introduced in its greatest generality showing their intrinsic nature. Definitions of different kinds of stability for generalized control systems are given, similar to those known for classical dynamical systems. It is also shown that stability for dynamical systems correspond to a strong and a weak similar property in the case of control systems. Examples are developed based on set theory. E.E.B.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N66-16254# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SITING AND DESIGN OF AIRPORTS
V. F. Babkov, ed. [1965] 912 p refs Transl. into ENGLISH of the book "Izyskaniya i Proyektirovaniye Aerodromov" Moscow, Nauchno-Tekhn. Izd. Min. Avtomob. Transp. i Shosseynykh Dorog RSFSR, 1963
(FTD-TT-65-99/1+2; AD-622357) CFSTI: HC $12.15/MF $3.50

Contents: Basic concepts of the general plan of airports; Dimensions of the movement area and of the airfield marginal area; Projection of airfield relief; Drainagle of flying-field territory; Design of artificial airport pavements; Design and construction of airport pavements; Design of airports in complex geographical conditions; Survey of airports and design. TAB

N66-16274 Joint Publications Research Service, Washington, D. C.
A CIRCULATING SOLAR WATER DISTILLER
A. Sh. Sharafi *In its* Heliotechnol. 3 Jan. 1966 p 34-36 ref (See N66-16266 07-34) CFSTI: $3.00

The operation of a circulating solar water distiller is briefly discussed. The distiller is basically a pan placed in a heat insulated box and covered with glass or transparent film. The operating principle is that a draught is created through a vertical pipe connected to the box. Air entering the distiller is moistened during passage through a moist gauze and by movement over the surface of the water. This moist air then passes through a condenser, becomes chilled, drops the distillate, and exits through a vent pipe. Included are formulas for calculating the quantity of distillate formed in the condenser, and methods for improving the efficiency. C.T.C.

N66-16424# Army Concept Team in Vietnam, San Francisco, Calif. 96243
UH-1 HELICOPTER SHELTERS Letter Report
Hugh E. Quigley 1 Oct. 1965 16 p refs
(AD-473407)

The purpose of the evaluation was to determine the suitability of the shelter, utility, tropical for use in the counterinsurgency environment of Vietnam as a UH-1 helicopter maintenance shelter. The UH-1 helicopter was used extensively in all areas of South Vietnam in counterinsurgency operations. Frequently, units were required to operate away from their permanent base, and aircraft maintenance was conducted in the field without adequate maintenance shelters. This problem was aggravated during the rainy season. Author (TAB)

N66-16440# Eidgenossiche Technische Hochschule, Zurich (Switzerland). Institut für Aerodynamik.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE VENTILATING SYSTEMS IN HIGHWAY TUNNELS [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN UBER DIE LUFTTUNGSANLAGEN VON STRASSENTUNNELN]
Alex Haerter 1961 110 p refs In GERMAN
Rept.-29) CFSTI: HC $4.00/MF $0.75

Aerodynamic calculations for ventilation systems of distributing and collecting highway tunnel systems that receive their fresh air supply from separate, parallel running ducts, are presented. Evaluated were the parameters of tunnel air velocity caused by through traffic, the density of traffic, traffic from the opposite direction, and the various meteorological and thermostatic pressure zones in the tunnel atmosphere. It was concluded that numerous ventilation openings alongside the tunnel are preferential to a single, centrally located ventilation system. Transl. by G.G.

N66-16559*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CALIBRATION EXPERIENCE IN THE LANGLEY HOTSHOT TUNNEL FROM MACH NUMBERS FROM 12 TO 26
Charles G. Miller, III, Theodore R. Creel, Jr., and Fred M. Smith Washington, NASA, Feb. 1966 48 p refs
(NASA-TN-D-3278) CFSTI: HC $2.00/MF $0.50 CSCL 14B

For a 0.100-inch nozzle throat diameter and arc-chamber stagnation temperatures of approximately 1700° and 2200°K, an axial Mach number gradient of 0.056 per inch was observed for the nozzle length examined to 150 inches. Variation in nozzle throat diameter from 0.025 to 0.500 inch (0.635 to 12.7 millimeters) for stagnation temperatures of 2200° to 2600°K resulted in test-section free-stream Mach numbers of 12 to 26. Boundary-layer-displacement thickness data were

observed to be in close agreement with semiempirical predictions for the range of nozzle throat diameters tested; boundary-layer thickness data for nozzle throats corresponding to free-stream Mach numbers of 11.8, 12.6, and 14.5 were in good agreement with predictions of a semiempirical relationship whereas a discrepancy was observed for all other nozzle throats tested. Force and moment coefficients obtained on a blunted cone having a 9° semiapex angle at a Mach number of 20 were in good agreement with results from other hypervelocity facilities. Author

N66-16617# Dayton Univ., Ohio. Research Inst.
COMPARISON OF TRANSIENT COMPRESSORS FOR THE PRODUCTION OF HIGH TEMPERATURE AND HIGH DENSITY GASES Technical Documentary Report, 15 Jun. 1963–30 Jun. 1965
John E. Minardi Wright-Patterson AFB, Ohio, ARL, Oct. 1965 38 p refs
(Contract AF 33(657)-8975)
(ARL-65-181; AD-625570) CFSTI: HC $3.00/MF $0.75

Research on systems for the production of high temperature and high density gases was conducted to determine the feasibility of various compressors to produce such gases. The report gives a comparison of the various systems that were studied and suggests systems that show promise of yielding greatly improved operation over systems presently available. Also reported is additional theory and data on membrane pistons used in conjunction with tapered tubes and data obtained with a NDEM Staged Piston System. Author (TAB)

N66-16647# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
THE AFCRL 29-FT MILLIMETER-WAVE ANTENNA
Leo M. Keane Oct. 1965 31 p refs *Its* Spec. Rept.-34
(AFCRL-65-726; AD-625170) CFSTI: HC $2.00/MF $0.50

A general description of AFCRL's new 29-ft parabolic antenna is given. This antenna, designed for operation at 35 Gc, has Cassegrain feed optics and a precise reflecting surface supported on an elevation over azimuth mount. Design parameters include a gain of 67.5 dB at 35 Gc and a pointing capability of better than ±1 arc min under 30-knot wind loads, normal solar loading, and peak accelerations of .012°/sec^2. The servo system was designed primarily to track objects traveling at sidereal rates. A limited satellite tracking capability should exist, however. Emphasis is given to engineering aspects of the tower, mount, drive system, and reflector assembly which should provide efficient rf operation and extreme precision in pointing. Author (TAB)

N66-16686*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.
MULTIDISCIPLINARY RESEARCH LEADING TO UTILIZATION OF EXTRATERRESTRIAL RESOURCES Quarterly Status Report, Oct. 1, 1965–Jan. 1, 1966
Thomas C. Atchison et al [1966] 14 p
(NASA Order R-09)
(NASA-CR-70041) CFSTI: HC $1.00/MF $0.50 CSCL 08I

Progress is reported on a study designed to provide the basic scientific and engineering knowledge needed for subsequent development of an extraterrestrial mineral resource extraction, processing, and utilization technology for supporting and enhancing the economy of manned lunar and planetary missions. M.R.W.

N66-16701*# Washington Univ., Seattle. Dept. of Aeronautical Engineering.
EXPERIMENTAL AND THEORETICAL INVESTIGATION OF WIND TUNNEL GEOMETRY, EMPHASIZING FACTORS PERTINENT TO V/STOL VEHICLES TESTING Progress Report No. 1, Sep. 16, 1964–Mar. 15, 1965
R. G. Joppa [1965] 11 p refs
(Grant NGR-48-002-010)
(NASA-CR-70043) CFSTI: HC $1.00/MF $0.50 CSCL 14B

The detailed objectives of the study were established within the general subject of V/STOL aircraft testing in wind tunnels. Personnel were engaged for the experimental phase and this work was begun with a survey and adjustment of flow in a 1/8 scale model of an 8×12 ft. wind tunnel modified to include a 21×19 ft. test section in tandem. Flow fields were measured and it was concluded that the tandem test section wind tunnel could provide an adequate aerodynamic environment for testing at low speeds. The velocity measured along the center line of the model tunnel was found to agree closely with that predicted by the vortex ring method. An experiment was designed to determine the effects of length of the large test section by use of a powered model which could be installed at various locations along the center line. Pilot tests were made to explore the problems of this experiment. Author

N66-16848 Argonne National Lab., Ill.
A LARGE SPARK CHAMBER MAGNET WITH TAPE WOUND COILS
G. E. Yurka, R. L. Kustom, and W. A. Siljander *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 253–261 refs (See N66-16826 07-23) CFSTI: $8.50

A 70-ton magnet with 50 x 60 x 30 inches useful volume for use in high energy physics experiments is described. The building block yoke design provides freedom in yoke steel arrangement around the coils. Tape wound coils allow a wider range of power densities than conventional coils. Impedance matching problems are solved by taps providing impedances of 25, 36.7, 50, and 100 milliohms. The short transverse cooling passages provide efficient cooling at low pressure, 125 psi maximum, permitting operation up to 11 MW power input. This corresponds to a power density of 972 W/lb of copper. A prototype coil of similar design was successfully tested up to a power density of 16 900 W/lb. The expected field for the present yoke arrangement, which only allows one pole tip, is 13 kilogauss at 5 MW and 17 kilogauss at 10 MW power inputs. Author

N66-16849 California Univ., Berkeley. Lawrence Radiation Lab.
COLLINS QUADRUPOLE MAGNETS AND SEXTUPOLE MAGNETS FOR GeV PROTON SYNCHROTRON
Robert A. Kilpatrick *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 262–267 refs (See N66-16826 07-23) CFSTI: $8.50

In the preliminary design of a 200-GeV proton synchrotron, new designs have been conceived for Collins quadrupole and sextupole magnets. These achieve savings in cross section, power consumption, and core complexity when compared with more conventional designs. Author

N66-16875 Commissariat a l'Energie Atomique, Saclay (France). Laboratoire de Physique Corpusculaire a Haute Energie.
A HIGH HOMOGENEOUS FIELD SUPERCONDUCTING MAGNET FOR A POLARIZED PROTON TARGET

Henri Desportes and B. Tsai *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 509–516 refs (See N66-16826 07-23) CFSTI: $8.50

A superconducting Helmholtz pair of coils, generating a 21 kilogauss magnetic field with a 10^{-4} homogeneity, has been built for use with a polarized proton target. This magnet allows very wide access to the target both radially and axially. It is made of Nb-Zr copper coated single wire and has been safely and reproducibly operated up to 17.5 amp with a stored magnetic energy in excess of 30 kilojoules. The field homogeneity showed slight deviations from the ideal calculated field, calling for readjustment of the geometrical parameters of the coils. Author

N66-16878 Brookhaven National Lab., Upton, N. Y.
A HIGH FIELD SUPERCONDUCTING SOLENOID FOR MAGNETIC MOMENT MEASUREMENTS ON SHORT-LIVED PARTICLES
W. B. Sampson *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 530–535 refs (See N66-16826 07-23) CFSTI: $8.50

A solenoid is described, which uses vapor deposited Nb_3Sn ribbon, to determine the gyromagnetic ratio of the negative xi particle. In order to facilitate rewinding or repairs, the solenoid has four concentric separable sections; coil forms are stainless steel and coated with teflon. The first section is stabilized by a field of approximately 20 kG; the second section continues to increase with applied field at 35 kG; the third section is found to give erratic results when operated with section four; but the outer section performs very well and produces a maximum field of 27 kG at 95 amps. Maximum field could be increased to about 125 kG with proper operation of the third section. The operating magnet is continuously supplied with liquid helium. M.W.R.

N66-16879 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).
A 90° SUPERCONDUCTING BENDING MAGNET FOR 30 MeV PROTONS
P. Kramer, H. L. Hagedoorn, and A. L. Luiten *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 536–540 refs (See N66-16826 07-23) CFSTI: $8.50

A superconducting magnet is described, which serves as a deflection magnet for a 30 MeV proton beam. The beam has to be deflected over 90° in a 50 kG field of 21 cm diameter. Superconducting solenoids can also be used as lenses. A comparison is made between the focusing properties of solenoids and quadrupole lenses. A discussion follows on the use of superconducting dynamos and gas refrigerating machines. Author

N66-16883 California Univ., Berkeley. Lawrence Radiation Lab.
AN INORGANICALLY INSULATED SUPERCONDUCTING SOLENOID FOR OPERATION AT 1°K
Ronald E. Hintz and Charles Laverick (ANL) *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 568–573 refs (See N66-16826 07-23) CFSTI: $8.50

An inorganically insulated 30-kG 2-in.-bore Nb-25%Zr solenoid for operation at 1°K is described. The thickness of the copper plating and the thermal environment prevented serious current degradation at 1°K. The insulation was sufficient to allow for a high charge rate with low heat input to the 1°K bath. Author

N66-16884 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
DESIGN, CONSTRUCTION, AND PERFORMANCE OF CRYOGENICALLY COOLED AND SUPERCONDUCTING ELECTROMAGNETS
James C. Laurence and Willard D. Coles *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 574–587 refs (See N66-16826 07-23) CFSTI: $8.50

Cryogenically cooled and superconducting electromagnets of large volume for research in plasma physics, solid state physics, and MHD power generation have been designed, constructed, and tested. One system of coils, wound from ultrapure (99.9983 percent pure) aluminum and cooled with liquid neon, has produced steady-state fields as large as 200 kG in a 11.2 cm bore and 80 kG in a 30 cm bore. Both magnets are in current use, providing intense fields of large volume for physics research. Superconducting coils have been wound from niobium–zirconium and niobium–tin wires and ribbons. These have produced fields as intense as 50 kG with niobium–zirconium coils and 80 kG with niobium–tin coils in a 10 cm bore. The performance of these coils, by themselves and in combination, to produce magnetic bottles with superimposed cusp fields will be described. Author

N66-16886 California Univ., Berkeley. Lawrence Radiation Lab.
A SUPERCONDUCTING MINIMUM B" MAGNET
Clyde E. Taylor and Charles Laverick (ANL) *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 594–596 *ref* (See N66-16826 07-23) CFSTI: $8.50

A nonsolenoidal superconducting magnet for studies in plasma confinement is described which has a field shape approximating the seam on a baseball. The minimum B magnet is illustrated as wrapped on a 10-in spherical test form as well when wrapped in its rather unique dewar for use in plasma confinement experiments. It is concluded that the construction of large superconducting magnets of unusual shape is practical, and that the cable can be unwound and rewound into different coil configurations without damaging the wire. M.W.R.

N66-16887 General Electric Co., Schenectady, N. Y. Research and Development Center.
STRANDED NIOBIUM–TIN WIRE SOLENOIDS: DESIGN AND FABRICATION TECHNIQUES
Carl H. Rosner and Mark G. Benz *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 597–603 refs (See N66-16826 07-23) CFSTI: $8.50

Design, construction and heat treatment techniques, used in the successful application of niobium–tin wire to high field superconductive solenoids, are discussed. While conventional coil winding practices have proved adequate, special coil form materials and terminal preparation techniques are necessary. Standard inert atmosphere heat treatment procedures can be used. Vacuum impregnation of the coils with silicone rubber after heat treatment prevents movement of the winding without reducing coil performance. Repeated high magnetic field level operation of these niobium–tin solenoids is in part attributable to protection techniques which allow fractional amounts of energy removal and transfer. The design approach has been scaled up to coil diameters of about four inches should also be suitable for larger bore coils. Author

N66-16888 Compagnie Generale d'Electricite, Paris (France).
A 4500 GAUSS SUPERCONDUCTING MAGNET FOR CORPUSCULAR IONOGRAPHY EXPERIMENTS USED AT CERN

L. J. Donadieu and Jean Royet *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 604–610 refs (See N66-16826 07-23) CFSTI: $8.50

The investigation of the charge inversion of 70 MeV pions implies a magnetic field of at least 40 kilogauss. The realization of a superconducting magnet designed for this purpose is described. The magnet is integrated with a specially designed cryostat which presents the particularity of a radial channel such that the magnetic field can be utilized at room temperature. The results of the tests of this magnet are discussed, particularly those of an effective operation on the synchrocyclotron of the CERN. The operation of the magnet without incident arises from several factors. One of these and probably the most important is the use of a superconductor as multistrands cable. The stabilized cable yields coils with improved performance presenting a reliability without comparison with coils made of single wire. A second factor is the close imbrication of the cryogenic technology to the superconducting magnet technology. The cryostate is unconventional in many regards, e.g., use of superinsulation, absence of liquid nitrogen shield, radial channel at room temperature, dismountability of the internal vessel, and accurate detection of the liquid helium level. E.E.B.

N66-16889 Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.

A CLOSED-LOOP COOLING SYSTEM FOR SUPERCONDUCTING BUBBLE CHAMBER MAGNETS

Henry H. Kolm *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 611–614 refs Sponsored by AF (See N66-16826 07-23) CFSTI: $8.50

A method is described for maintaining a structure at liquid helium temperature and the advantages of such a system over bath immersion technique are summarized. The method relies on the reluctance of helium to solidify at pressures substantially above the critical point. In this domain helium has the properties of a highly compressible fluid or a very dense gas. Also, it has a very low viscosity and is incapable of undergoing phase change. It therefore represents a virtually ideal heat transfer medium which can be circulated through a system of small diameter tubing permeating a superconducting structure. A circulation system is proposed which makes it possible to use all available vapor enthalpy for cool-down as well as heat removal from massive current leads and support structures. In the temperature range between 4° and 20° K the heat transfer between the supercritical helium and the inside wall is conservatively characterized by a coefficient of 0.223 W/cm^2-deg. Two small scale heat transfer systems using supercritical helium were constructed with a nominal capacity of one watt to explore the feasibility of larger units. E.E.B.

N66-16890 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.

FLUX PUMPS AS POWER SUPPLIES FOR SUPERCONDUCTING COILS

S. L. Wipf *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 615–624 refs (See N66-16826 07-23) CFSTI: $8.50

Various types of flux pumps have been studied in view of their applicability for powering superconducting coils. Experimental performance tests are in reasonable agreement with a simple mathematical treatment. Successful tests were made on a model without moving parts, operated by three-phase ac; and on various modifications of two rotating pumps. One version powered a coil of 77 strand Nb-25%Zr cable up to its critical current of 1500 A. Measurements were made of the losses which have to be absorbed in the helium and the efficiency was found to be smaller than 30%; improvements in design should raise this to over 50%. Author

N66-16891 National Bureau of Standards, Boulder, Colo. Cryogenics Div.

CRYOGENIC COIL FOR MEGAJOULE ENERGY STORAGE

Vincent Arp *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 625–629 refs (See N66-16826 07-23) CFSTI: $8.50

A cryogenic magnet is described which meets the specifications of a 10^6 joule inductive energy storage system. The availability of high purity aluminum cuts down magnet production costs, although the cost of assembly, the dewar vessel, and cryogenic components are expensive. Most critical factor in the design is concerned with the effect of mechanical stress on the electrical resistivity of the aluminum at low temperatures; and in this case the aluminum has a resistivity ratio between room temperature and 4°K of about 4000. Stress levels in the designed system are held to a conservative value, but their use for much larger systems will require additional studies. M.W.R.

N66-16895 California Univ., Berkeley. Lawrence Radiation Lab.

A NANOSECOND FERRITE-CORE MAGNET SYSTEM FOR BEAM SWITCHING

William L. Gagnon, D. T. Scalise, and Bob H. Smith *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 657–662 refs (See N66-16826 07-23) CFSTI: $8.50

The paper describes an experimental study of a kicker magnet for the extraction system of a synchrotron. The magnet which uses ferrite as the return yoke, has a gap of 2 in., and a pole tip area of 12 in.^{2}. The maximum field is 2.5 kG, which is established with a rise time of about 100 nsec. The pulse length for the magnetic field is 4.8 μsec, and the repetition rate is 60 pulses/sec. The magnet is excited from a coaxial, lumped-constant, pulse line. Construction techniques employed and theoretical limitations of this type of system are discussed. Author

N66-16896 Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).

100-300 kG PULSED BUBBLE CHAMBER MAGNET

W. H. Bergmann *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 663–679 refs (See N66-16826 07-23) CFSTI: $8.50

The development of a propane test bubble chamber for fields up to 300 kG is summarized. The field coil is used as the bubble chamber body to circumvent eddy current problems and to best utilize the available field volume. The field coil and its energy storage aggregates are shown schematically. Fabrication processes are described in detail. Also, characteristics and capabilities of the chamber are discussed. E.E.B.

N66-16898 Carnegie Inst. of Tech., Pittsburgh, Pa.

VAN DER MEER MU MESON CHANNEL

M. Foss and R. Sutton *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 684–685 (See N66-16826 07-23) CFSTI: $8.50

A Van der Meer ion guide which is used as a muon channel is described. The device is a large coaxial current system. The solenoidal magnetic field between the inner and outer conductors pushes the ions toward the axis as they travel down

the coaxis. The channel is 54 feet long with a 0.666 inch O.D. inner and a 10 inch I.D. outer conductor and a vacuum inbetween. The acceptance is 4 radians^2 cm^2 with a current of 12 000 A. The average current density in the central conductor is 35 000 A/sq inch at 12 000 A. The conductor has an 1/8 inch copper rod wound with an edgewise wound copper spring. This is enclosed in a heavy walled copper tube. About 20 square centimeters of heat transfer area per centimeter of length are provided. Cooling water is changed every 9 feet. The power of 7.5 kV/ft is removed by 6 gpm of 150 psi water. E.E.B.

N66-16899 Oerlikon Machine Tool Works, Zurich (Switzerland).

DESIGN AND CONSTRUCTION OF THE EXCITING COILS FOR THE GUIDING MAGNET OF A 4GeV ELECTRON SYNCHROTRON

Peter A. Tschopp *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 686–699 (See N66-16826 07-23) CFSTI: $8.50

The single layer coils are constructed from multi-strand copper cable of rectangular cross-section, four cables bound together forming the turns of the coil. Water cooling is effected by cooling tube loops placed on top of the coil and soldered to cooling-fins inserted between the turns. For the overall insulation to ground, coils are wrapped 4 mm thick with glass-mica insulation vacuum-impregnated in molds with Orlitherm epoxy resin. The coils are self-supporting units able to withstand all thermal, mechanical and electromagnetic stresses during test conditions and in service. As in service the coils are subjected to an intense radiation environment, the choice of materials used in the construction has been limited to those known to have a high irradiation stability. Author

N66-16900 Oak Ridge National Lab., Tenn.

EXTRACTION MAGNETS FOR CYCLOTRONS

E. D. Hudson and R. S. Lord *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 700–708 ref (See N66-16826 07-23) CFSTI: $8.50

Three types of magnetic channels meeting the varying requirements for beam extraction from cyclotrons are described. They produce field reductions of up to 9,000 gauss for the deflected beam, but only a few gauss of first harmonic in the region of the circulating beam. The power levels are on the order of 200 kW. Author

N66-16901 Oak Ridge National Lab., Tenn.

SECTOR MAGNETS FOR A SEPARATED ORBIT CYCLOTRON

R. S. Lord and E. D. Hudson *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 709–714 refs (See N66-16826 07-23) CFSTI: $8.50

The separated orbit cyclotron (SOC) consists of individual sector magnets placed alternately with rf cavities in a circular arrangement. In each magnet sector the beam is bent and focused by alternating gradient fields: ten to twenty pairs of pole tips, depending on design, are mounted on a common yoke and driven by a common coil pair. A variable reluctance device under each pole can be used to adjust the field to the desired value. Model studies have been made, and a 50-ton prototype sector magnet for a 50-MeV SOC is being fabricated for further study. Author

N66-16904 Argonne National Lab., Ill.

PRESTRESSING METHOD FOR ASSEMBLING THE ARGONNE ZGS RING MAGNET COILS

W. A. Siljander *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 733–744 refs (See N66-16826 07-23) CFSTI: $8.50

The ZGS ring magnet coils are subjected to a pulsating magnetic force of zero to twelve tons per linear foot every two seconds and thermal forces of forty-two tons at the ends. In spite of these large forces, the movement of the 60-foot long coils during operation was held to less than .002 inch. An unusual method of installing the coils, called prestressing, was responsible for this achievement. Major considerations and techniques in the design, fabrication, testing, and installation of the ring magnet coils to accomplish this prestressing method are discussed. Author

N66-16905 Leiden Univ. (Netherlands). Kamerlingh Onnes Lab.

NEW MAGNET INSTALLATIONS AT THE KAMERLINGH ONNES LABORATORY

D. de Klerk *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 745–752 refs (See N66-16826 07-23) CFSTI: $8.50

A four megawatt rectifier installation which supplies fields up to 80 000 Oe in coils of 8.6 cm internal diameter, a condenser battery of 180 kilojoules which provides fields up to 380 000 Oe in coils of 12 mm internal diameter, and superconducting coils energized by Leiden flux pumps are discussed. Characteristics and parameters are given for each of these installations. E.E.B.

N66-16907 General Electric Co., Schenectady, N. Y.

CONSIDERATIONS IN APPLYING ACYCLIC GENERATORS FOR PULSE-DUTY IN MAGNET POWER SUPPLIES

R. W. Cooney, L. M. Harvey, and M. D. Horton *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 769–775 (See N66-16826 07-23) CFSTI: $8.50

The application of a flywheel-acyclic generator power supply is programmed and checked on an analog computer for application on a 120 000 kW pulse on a bubble chamber magnet. This confirmed that the pulse could be generated at 15 second intervals with apparent economies over other systems. Author

N66-16908 Midwestern Universities Research Association, Stoughton, Wis.

POWER SUPPLY FOR THE MURA MAGNET MODELING PROGRAM

Frank L. Peterson *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 776–778 refs (See N66-16826 07-23) CFSTI: $8.50

The MURA magnet modeling program requires a flexible, dc current regulated power supply in the 200 kW range. Two generators are mounted on each side of a synchronous motor. The generators are equipped with a series differential winding which reduces the remnant current as well as enabling them to the be operated in parallel without regulation. The rating of each generator is 1500 A, 75 V, and the motor is 350 hp. The basic control element is a water-cooled transistor bank in series with the shunt field. The current sensing device is a commercial transducer with a current ratio of 2000 to 1. Because the generators operate at a fairly high noise level, they are housed in a separate uninsulated building with only a nominal amount of heating to prevent the lubrication from becoming stiff enough to prevent them from starting in winter. Therefore, the generators operate over a wide ambient temperature range during warmup as well as from day to day. E.E.B.

N66-17018# RAND Corp., Santa Monica, Calif.
SOME THOUGHTS ON RANGE PLANNING AND OPERATION
Raoul J. Freeman Dec. 1965 15 p refs
(P-3246; AD-624523) CFSTI: HC $1.00/MF $0.50

The paper discusses various facets of range planning and operations. Some mathematical formulations of certain aspects of these areas were made. With the ever increasing scope of our nation's space and missile program, even greater responsibility falls upon the ranges for support. In order to fulfill their missions as best as possible, utilization of quantitative methods will become a self-evident necessity.
Author (TAB)

N66-17054*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM, VOLUME B. PART VIII: ADVANCED TECHNOLOGY AND SUPPORTING RESEARCH
21 Feb. 1966 126 p refs
(Contract NASw-1215)
(NASA-CR-70347) CFSTI: HC $4.00/MF $1.00 CSCL 22A

An illustration is presented of the application of a previously derived synthesis framework to construct an Orbital Research Laboratory (ORL) experiment program in support of advanced technology and supporting research. The objectives of this area are to establish a base of fundamental knowledge underlying design of advanced space systems, subsystems, and components. Consideration is given to the identification of selected knowledge requirements and the derivation of experiment requirements. These include equipment functional and supporting research requirements, and prospective orbital activities. Illustrative selected knowledge requirements, and discussions of representative experiments are appended. C.T.C.

N66-17088*# Washington Univ., Seattle. Dept. of Aeronautical Engineering.
EXPERIMENTAL AND THEORETICAL INVESTIGATION OF WIND TUNNEL GEOMETRY, EMPHASIZING FACTORS PERTINENT TO V/STOL VEHICLES TESTING Progress Report No. 2, Mar. 16-Sep. 15, 1965
R. G. Joppa 15 Jan. 1966 26 p refs
(Grant NGR-48-002-010)
(NASA-CR-70331) CFSTI: HC $2.00/MF $0.50 CSCL 14B

Discussions are presented of an experiment concerning the installation of a powered rotor model in a wind tunnel; an analysis of tunnel internal flow using the vortex ring method; and the basic problem of calculating flow fields of highly loaded systems in free air. The wind tunnel analysis was extended and improved by distributing the vorticity from discrete rings to continuous sheets along the walls. Relative to calculating flow fields, it was found that a simple representation of the vortex system was adequate to calculate the trajectory of a streamline. In determining interference it was demonstrated that the vortex filaments trail downward at about one-fourth the angle of the mass of air as calculated by simple momentum theory. C.T.C.

N66-17169# Brookhaven National Lab., Upton, N. Y.
ALPHA-GAMMA FACILITY FOR METALLURGICAL EXAMINATIONS
P. Richards, A. Banslaben, and J. Chow 2 Sep. 1965 13 p
(Contract AT(30-2)-GEN-16)
(BNL-9502) CFSTI: HC $1.00/MF $0.50

The design and operation of a facility for cutting, polishing, and testing the metallurgical properties of irradiated in-pile loops and capsules are described. NSA

N66-17170# Brookhaven National Lab., Upton, N. Y.
LARGE HYDROGEN BUBBLE CHAMBER DESIGN
R. B. Palmer 31 Mar. 1965 15 p Presented at the CERN Informal Neutrino Conf., Geneva, 20-22 Jan. 1965
(Contract AT(30-2)-GEN-16)
(BNL-9146; CONF-650111-5) CFSTI: HC $1.00/MF $0.50

A description is given of a proposed 14-ft-dia nearly spherical hydrogen bubble chamber. The problems involved in illumination, photography, beam physics, magnetic-field production, and production of multiple expansions of the chamber during one beam pulse (from the Brookhaven AGS) are reviewed. The characteristics of Ne and propane as working gases for the chamber are discussed. The concept of using Ne as the filler gas, with a bag full of H_2 in the center of the chamber, is analyzed. NSA

N66-17217*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A VERTICAL TEST RANGE FOR ANTENNA RADIATION MEASUREMENTS
John Steckel and William Korvin [1963] 52 p refs Submitted for Publication
(NASA-TM-X-56076) CFSTI: HC $3.00/MF $0.50 CSCL 14B

A vertical test range configuration composed of an electrically small termination chamber with a r-f transparent radome was studied for its ability to provide satellite antenna radiation patterns at the frequency range of 125 to 400 Mc. The structural A-sandwich radome reduced the performance of the facility at higher frequencies. Therefore it was recommended that a thick, low-dielectric-constant foam radome be used to improve the facility for accurate measurements of antenna characteristics. G.G.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N66-16218# Space Technology Labs., Inc., Redondo Beach, Calif.
LIQUID SLOSHING IN A MOVING TANK WITH A TIME DEPENDENT DISCONTINUOUS BOUNDARY
Gordon C. K. Yeh Jun. 1964 27 p refs
(STL-6438-6002-RU-000; EM-14-12)

The problem of the sloshing of a liquid in a vertically moving cylindrical tank with a specified time dependent boundary condition at the outlet of the tank bottom is studied. Both axisymmetric and asymmetric modes are considered. The general differential equations are derived and the stability criteria of the solution are given. The complete stable solution is formulated. For the case where the tank does not move and a steady-state discontinuous boundary condition is specified the solution is obtained in detail. Special cases are shown to agree with the previously known results of Benjamin and Ursell and Bhuta and Yeh. The analysis is useful in studying the longitudinal stability and response of a system containing a liquid-filled tank with or without an outlet at its bottom.
Author

N66-16227# Syracuse Univ. Research Inst., N. Y. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATIONS ON REGIONS OF NEGATIVE TURBULENT ENERGY-PRODUCTION Annual Technical Report, Oct. 1964–Oct. 1965
Fadel Erian Nov. 1965 23 p refs
(Contract Nonr-669(16))
(ME937-6511; AD-624302) CFSTI: HC $1.00/MF $0.50

The turbulent energy equation was investigated with particular emphasis on the mechanism of negative energy production. A new electronic equipment was constructed for the measurement of triple correlation terms given by $\overline{uq}^2$ and $\overline{vq}^2$. A measuring system was developed which could produce the values of $\overline{up}$ and $\overline{vp}$. The existing flow field was manipulated so that the regions of negative energy-production, usually very small, could be enlarged so that instrumentation could be introduced without much difficulty. Author (TAB)

N66-16234*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE STRUCTURE OF THE VISCOUS HYPERSONIC SHOCK LAYER
L. Goldberg Dec. 1965 67 p refs
(Contract SNPC-29)
(NASA-CR-69831; R65SD50) CFSTI: HC $3.00/MF $0.75
CSCL 20D

A unified, theoretical model of the hypersonic viscous shock layer is presented, which covers the entire range of shock Reynolds number from 0 (50) to 0 (10^4), including the effects of mass transfer. At the lowest Renolds numbers considered, merging of the fully viscous shock layer with the shock wave occurs, and at the highest Reynolds numbers, the boundary layer asymptote is approached. In addition, in order to compare the new results obtained from this new system of equations and boundary conditions at high Reynolds numbers with those obtained from boundary layer solutions for precisely the same hypersonic flight conditions, the boundary layer equations have been reformulated by retaining only first order terms. Correlated results of the numerical solutions obtained on a high speed digital computer for both systems of equations are presented. The range of hypersonic flight conditions include flight velocities from 10000 ft/sec. to 25000 ft/sec.; altitudes from 100000 ft. to 350000 ft; shock Reynolds numbers from order 10 to order 10^4; surface temperatures from 800°R to 3500°R; and dimensionless mass transfer rate parameter f_w from 0 to −0.4. Author

N66-16257# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
THEORETICAL STUDY OF A STIFF LAMINAR BOUNDARY LAYER WITH SEVERAL DISCONTINUITIES OF CATALYSIS [ETUDE THEORIQUE D'UNE COUCHE LIMITE LAMINAIRE FIGEE AVEC PLUSIEURS DISCONTINUITES DE CATALYSE]
Gerard Lasseu and Bernard Le Fur Nov. 1965 41 p refs In FRENCH *Its* Publ.-249
(Rept.-65-10) CFSTI: HC $2.00/MF $0.50

The catalytic effect of a vehicle wall during reentry on the boundary layer composed of a gas mixture in metastable equilibrium is considered. A simple analogy is presented in which a flat plate parallel to the velocity vector replaces the vehicle wall; the boundary layer is taken as laminar; and the chemical reaction is assumed to be binary and of the first order. The concentration of gas within the boundary layer is calculated for large Schmidt numbers. Transl. by D.T.

N66-16289 Saskatchewan Univ., Saskatoon. Div. of Control Engineering.
FLUID DYNAMIC EFFECTS OF LIQUIDS IN ELASTIC TUBES
R. W. Besant and V. Srinivas *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 47–78 refs (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75
(Grants DRB G-9550-15; NRC A-1080; NRC A-2754)

A theoretical analysis is made of the frequency response of a liquid flow in an elastic line with an input oscillator and a load; and experimental results are presented for an oscillating liquid flow in a long elastic tube with and without a load. In the theoretical analysis, linearized equations for the flow of a viscous incompressible liquid are considered. Frequency responses of interaction, transverse, and longitudinal wave modes are analyzed for the system by linearizing the general partial differential equations of motion for the liquid and the elastic tube by superimposing second order effects on the first order equations, which results in superimposed resonant frequencies for each wave mode. Comparison is made between these theoretical findings and the frequency response of pressure and velocity with and without a load; and phase lags are presented. Both interaction and transverse wave modes were observed, and these waves showed strong attenuation and dispersion with frequency as indicated by the theory. Effective bulk modulus, load impedance, and both dimensional and nondimensional form are considered. M.W.R.

N66-16290 Harry Diamond Labs., Washington, D. C.
TRANSIENT RESPONSE OF A FLUID LINE WITH AND WITHOUT BLEEDS
William H. Walston, Jr. *In its* Proc. of the Fluid Amplification Symp., Vol. II [1965] p 79–111 refs (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

The theory of characteristics is applied to determine the transient response of rectangular ducts to a step input, which is generated by a unique film-snatching apparatus. The output pulse of the duct is shaped by a nozzle termination and by the addition of side branches to the duct. Only subsonic flow is considered. Experimental results that confirm the theoretical predictions are presented. Author

N66-16292 IIT Research Inst., Chicago, Ill.
SOME INFLUENCES OF TURBULENCE ON THE NOISE OF PROPORTIONAL FLUID AMPLIFIERS
Dennis W. Prosser and Michael J. Fisher *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 129–162 refs (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75
(Contracts DA-49-186-AMC-101-C(D); DA-49-186-AMC-192 (D))

Noise, defined as the undesirable pressure fluctuations which turbulence superimposes on the mean pressure signal measured at a receiver placed in a fluid jet, is considered in terms of adverse effects on the performance of a proportional fluid amplifier. Basic equations for signal and noise are evolved; and expressions are given for signal to noise ratio and the coefficient of noise. Analytic evaluations are made of some of the basic equations, the relationship between mean shear and turbulent intensity is tabulated, and point and finite receivers are considered. Despite limited results, the influence of noise on proportional amplifiers is shown when the receivers are located entirely above the jet axis. For receivers above the x-axis, both the signal to noise ratio and the coefficient of noise become smaller as the receiver width increases. Based on results with a few receivers spanning the x-axis, signal to noise ratio becomes a minimum when the receiver midpoint lies on the x-axis; whereas the noise coefficient approaches infinity under this condition. M.W.R.

N66-16298 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PROFILES OF VELOCITY COMPONENTS AND RADIAL PRESSURE DISTRIBUTION IN A VORTEX CONTAINED IN A SHORT CYLINDRICAL CHAMBER
Joseph M. Savino and Edward G. Keshock *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 269–299 refs (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

The chamber was formed by two 11.72-inch-diameter disks spaced 1.25 inches apart. A high swirl was imparted to the fluid (air) as it entered the chamber through 48 tangentially alined vanes. A 2-inch-diameter tube at the center of one disk served as the exhaust port. Static pressure and the profiles of the radial and tangential velocity components were measured at 8 radial stations. All the radial inflow took place close to the disk surfaces, while a slow outward flow existed in midchannel. The tangential velocities were used to predict the static pressures which agreed well with the measured values. Author

N66-16299 Nebraska Univ., Lincoln. Hydrodynamics Lab.
A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE VORTEX-SINK ANGULAR RATE SENSOR
Turgut Sarpkaya *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 301–329 refs (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75
(Contract DA-49-186-AMC-128(X))

This paper describes the characteristics of flow of a viscous fluid between two rotating coaxial disks separated by a porous cylindrical wall. The sensitivity of the device to rotational motion has been determined for various flow rates, angular velocities, and types of pickoffs. The viscous efficiency of the sensor has been determined theoretically and compared with that obtained experimentally. It is found that the device as well as the pickoff may be designed for a given range of operation and maximum rate detection through a combination of theoretical and experimental studies. Author

N66-16300 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLOW STUDIES IN A VORTEX RATE SENSOR
R. F. Hellbaum *In* HDL Proc. of tae Fluid Amplification Symp., Vol. II [1965] p 331–345 (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

Effects of various geometrical design parameters on vortex rate sensor flow patterns were investigated to provide data for making improvements in the design of vortex chambers and output pickups. Changes in flow pattern, obtained by smoke-trace pictures of airflow in a large vortex chamber, were studied by independently varying each parameter. Flow rate, coupling element diameter, exhaust orifice diameter, and cylinder height were the parameters considered for a thin, right-circular, cylindrical chamber. The ratio of tangential to radial component of velocity is observed to increase with a decrease in flow rate, indicating that optimum radius-to-height (R/h) ratios may exist for various flow rates. At the maximum point, the inertial and viscous effects are of the same order; further increase of R/h leads to domination by viscous effects because each fluid particle must travel a longer path nearer the walls. M.W.R.

N66-16301 Bendix Corp., Southfield, Mich. Energy Conversion and Dynamic Controls Lab.
PHOTOVISCOUS FLOW VISUALIZATION IN FLUID STATE DEVICES
Endre A. Mayer *In* HDL Proc. of the Fluid Amplification Symp., Vol. II [1965] p 347–361 refs (See N66-16286 07-03) CFSTI: HC $7.00/MF $1.75

Photoviscosity is an excellent flow visualization technique applicable to a variety of fluid state components. A number of liquids exhibit double refracting properties which are a function of the viscous shear stress exerted on the liquid. The viscous shear is proportional to the velocity gradient in liquids, and the interference pattern is thus a function of the flow field. The photoviscous art was advanced significantly in 1953 by reporting the photoviscous properties of a milling yellow dye (MYD) solution. The MYD solution is highly sensitive, easy to prepare and handle, and its viscosity is similar to that of hydraulic oils. Additional significant milestones in the use of photoviscosity with appropriate references are listed in the paper. Typical results of photoviscous studies in noise investigation of proportional jet deflection amplifier design are shown. The switching transients of wall attachment jet devices are demonstrated for straight and cupped splitter designs. The demarcation between laminar and turbulent flow regimes may be seen in the various still pictures. The flow interaction between the tangential control jets and the radial supply flow in vortex chambers of different designs is also demonstrated for various levels of vorticity. Author

N66-16363# California Univ., Berkeley. Space Sciences Lab.
LOCAL SKIN FRICTION AND INDUCED PRESSURE MEASUREMENTS ON A SHARP-EDGED INSULATED FLAT PLATE IN A LOW DENSITY HYPERSONIC FLOW
E. S. Moulic, Jr. 10 Jan. 1966 115 p refs *Its* Tech. Rept.: Ser. 7, Issue No. 3
(Grant NSF GP-2520)

Local skin friction and induced pressure measurements were made in the region near the sharp leading edge of an insulated flat plate for hypersonic low density free stream test conditions of $5.2 < M_\infty < 6.0$, $47 < Re_{x,\infty} < 3400$, $3.5 < \overline{\chi}_\infty < 20$. Strong rarefaction effects were apparent in the data and it was tentatively concluded that a pure strong interaction region did not exist. In the viscous interaction region first order weak interaction theory was in satisfactory agreement with the data. The beginning of the region of significant rarefaction effects occurred at $M_\infty C_\infty^{1/2}/Re_{x,\infty}^{1/2} = 0.25$, which is in agreement with a wide range of other experimental results. A merged layer analysis showed the most promise for this region but more theoretical developments are needed. The heretofore unrecognized importance of pressure tap configuration effects in the leading edge region was experimentally demonstrated. Author

N66-16356# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE INFLUENCE OF THE INTERACTION OF DISSIPATIVE AND ISENTROPIC STREAMS ON THE FLOW IN THE BASE REGION OF A BODY MOVING AT HYPERSONIC VELOCITY
L. I. Myshkova [1965] 12 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), no. 19, 1965 p 112–119

Mixing zone characteristics at the boundary of the stagnation zone and the external potential flow of a body moving in a hypersonic stream were studied by asymptotic series expansion methods. It was found that in the presence of interactions the pressure on the external boundary of the dissipative layer exceeds the value of the pressure under conditions when the mixing zone does not exert any essential effect on the external flow configuration. The greatest effect of the induced pressure is manifested near the trailing edges. Experimental studies

showed that for $5 \leq M_\infty \leq 8$ the induced pressure affects primarily the velocity distribution in the separation zone. At $M_\infty > 8$, the influence of the induced pressure is also extended to the deceleration-temperature profile. G.G.

N66-16441# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
EFFECT OF THE REYNOLDS NUMBER AND THE BOUNDARY LAYER THICKNESS ON THE BASE PRESSURE ON WEDGE FLOWS [EINFLUSS DER REYNOLDSZAHL UND DER GRENZSCHICHTDICKE AUF DEN TOTWASSERDRUCK BEI DER UMSTROMUNG VON KEILEN]
M. Tanner May 1965 38 p refs in GERMAN; ENGLISH summary
(DLR-FB-65-18) CFSTI: HC $2.00/MF $0.50

Wind tunnel measurements on wedges in incompressible two-dimensional flow were performed to explain the effect of the Reynolds number and the boundary layer thickness on the base pressure. The results show that the base pressure is independent of the Reynolds number but increases to some extent with increasing boundary layer thickness. Author

N66-16442# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
PRESSURE DISTRIBUTION MEASUREMENTS ON CONES [DURCKVERTEILUNGSMESSUNGEN AN KEGELN]
M. Tanner Feb. 1965 41 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-09) CFSTI: HC $2.00/MF $0.50

Pressure distribution measurements were made on cones in a symmetrical incompressible flow with and without wake influence. The base pressure coefficients, drag coefficients and the nondimensional theoretical outflow from the base region are presented as a function of the cone angle. The results show, that the axially symmetric base flow is essentially steady in character. The theoretical outflow for the circular disk agrees well with measurements of another author. Author

N66-16557*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INVESTIGATION OF HIGHLY UNDEREXPANDED EXHAUST PLUMES IMPINGING UPON A PERPENDICULAR FLAT SURFACE
Allen R. Vick and Earl H. Andrews, Jr. Washington, NASA, Feb. 1966 57 p refs
(NASA-TN-D-3269) CFSTI: HC $3.00/MF $0.50 CSCL 01A

The results of this investigation showed three different shock structures within the exhaust plume which were dependent upon the distances from the nozzle exit to the impingement surface and the ratio of the nozzle total pressure to the ambient pressure. The three types of shock structures consisted of (1) a surface shock located at a constant distance from the surface, (2) a shock acting similar to a Mach disk, which was located closer to the nozzle exit than it would be if no impingement surface were presented and for which the distance from the nozzle exit decreased as the ratio of nozzle total pressure to ambient pressure decreased, and (3) a crossed oblique shock with a near-normal shock adjacent to the impingement surface. The type of shock exerted considerable influence on the surface-pressure distributions. At small distances from the nozzle exit to the surface and with the surface shock at a constant standoff distance, maximum surface pressures occurred on the nozzle axis and decreased in a smooth continuous manner with increasing radial distances. For these conditions a single curve was found to represent the radial variation of the ratio of the surface static pressure to the nozzle total pressure for the entire range of test pressure ratios. Author

N66-16587*# Southwest Research Inst., San Antonio, Tex.
MOMENT OF INERTIA AND DAMPING OF LIQUIDS IN BAFFLED CYLINDRICAL TANKS
Franklin T. Dodge and Daniel D. Kana Washington, NASA, Feb. 1966 29 p refs
(Contract NAS8-1555)
(NASA-CR-383) CFSTI: HC $2.00/MF $0.50 CSCL 20D

The moment of inertia and the damping of a liquid in a completely filled, closed cylindrical tank is investigated experimentally for tanks with and without baffles. The results are compared with Bauer's mechanical model, and it is shown that a simpler model, which, however, is not conceptually correct for extremely large damping, is sufficient for cases where only small damping is expected. An approximate method of computing the liquid moment of inertia in a baffled tank is given. Author

N66-16630# New York Univ., N. Y.
AN APPROXIMATE SOLUTION OF THE CROCCO EQUATION
Charles J. Ruger Wright-Patterson AFB, Ohio, ARL, Oct. 1965 46 p refs
(Contract AF 33(615)-2215)
(ARL-65-210; AD-625206) CFSTI: HC $2.00/MF $0.50

The Crocco equation for zero pressure gradient and a constant viscosity-density product is linearized and the results applied to boundary layer problems where the given initial profile is much different from Blasius profile. Three linearization assumptions are used, each of which leads to an eigenvalue problem having a discrete spectrum of eigenvalues. This allows the shear stress to be expressed as a series. Far downstream of the initial station the first term of this series dominates. Solutions valid in this region are obtained for each assumption and are compared to the exact similar solution. The best of the three assumptions is applied to two examples where it is desired to find the flow behind a region having mass injection. Comparison to finite difference solutions shows the present solution to be satisfactory and superior to solutions obtained by perturbations from the Blasius solution. Author (TAB)

N66-16634# New York Univ., N. Y.
ON THE INITIAL CONDITIONS FOR BOUNDARY LAYER EQUATIONS
Lu Ting Wright-Patterson AFB, Ohio, ARL, Oct. 1965 33 p refs
(Contract AF 33(615)-2215)
(ARL-65-208; AD-625207) CFSTI: HC $2.00/MF $0.50

A three dimensional boundary layer with two components of velocity, v, w, much smaller than the third component, u, which is along the inviscid stream line, the x-coordinate, is studied. It is shown that the boundary layer equations lead to a compatibility equation on the four initial data of the three velocity components and the density, while the enthalpy is related to density by the equation of state. When the four initial data prescribed at a station, $x=0$, are inconsistent with the compatibility equation, the solution in a thin initial strip near $x=0$ will not fulfill the usual boundary layer equations. In this thin initial strip, a new set of governing equations are derived by stretching all three coordinates. By the examination of the general properties of the solutions in the thin strip and by the standard matching procedures, it is shown that the three

proper initial conditions to be imposed on the boundary layer equations are the density profile, the velocity component u and a third quantity which is neither v nor w but a combination of the four prescribed initial data. An alternate derivation of these proper initial conditions and their physical interpretation is presented by the direct balance of mass, momentum and energy across the thin initial strip. Author (TAB)

N66-16638# California Univ., Berkeley. Inst. of Engineering Research.

SPHERE DRAG AT HIGH KNUDSEN NUMBER AND LOW MACH NUMBER

D. Roger Willis Oct. 1965 22 p refs

(Contract Nonr-222(45); Grant NSF GP-2520)

(AS-65-16; AD-625622) CFSTI: HC $1.00/MF $0.50

The drag of a sphere is calculated for the case of low Mach number and high Knudsen number. The method of Knudsen iteration is used to predict the drag correct to order of the inverse Knudsen number. The Bhatnagar–Gross–Krook model is used to describe the intermolecular collision process.

Author (TAB)

N66-16688# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Fluid Dynamics Facilities Lab.

OBSERVED SUPERSATURATION IN THE ARL 20-INCH HYPERSONIC WIND TUNNEL

Richard T. Goddard Oct. 1965 28 p refs

(ARL-65-214; AD-625253) CFSTI: HC $2.00/MF $0.50

An experimental investigation of the condensation of air in a hypersonic wind tunnel was carried out. The experimental work was conducted in the ARL 20-inch hypersonic wind tunnel which utilizes a contoured nozzle to expand the flow to Mach 14 with stagnation temperatures up to 2100°R at free stream Reynolds of 300,000 per foot to 1,000,000 per foot. Pitot probe surveys were made at the nozzle exit and at axial locations upstream of the nozzle exit. Surveys at the nozzle exit showed that the only indication of apparent condensation was a slight change in the slope of the pitot pressure versus free stream temperature curve. However, upstream surveys indicated a slight increase in pitot pressure at the critical temperature with the percent of increase becoming greater at higher stagnation pressures. Therefore, it was concluded that the relaxation time (axial location) and the Reynolds number (variance of stagnation pressure) are the primary factors contributing to the pitot pressure sensitivity at the onset of condensation. The report also presents the experimentally determined operating regime of the ARL 20-inch hypersonic tunnel. Author (TAB)

N66-16715*# Southwest Research Inst., San Antonio, Tex.

[PRESSURES ON RING BAFFLES. DAMPING COEFFICIENTS FOR MECHANICAL MODELS OF LIQUID SLOSHING] Quarterly Progress Report No. 16, 1 Jan.–31 Mar. 1965

H. Norman Abramson 5 Apr. 1965 12 p refs

(Contract NAS8-1555)

(NASA-CR-70021) CFSTI: HC $1.00/MF $0.50 CSCL 20D

A harmonic analysis of ring baffle pressure data is reported. Data reduced by the peak amplitude measurement method yielded good results for the ring section normal to the excitation amplitude. Erratic pressures at other ring sections are the results of data taken for peak pressure-force measurements. At frequencies corresponding to these measurements, the liquid motion is comprised of a combination of the first antisymmetric and symmetrical sloshing modes. It is indicated that these two modes are the dominant harmonics. In addition, experimental force measurements for solid and perforated ring baffles were completed and the data reduced. Preliminary results indicate that the force measurements on a solid ring baffle are in a range bounded by two different theoretical force computations. Curves are given showing the experimental non-dimensional force measurement vs baffle submergence for three values of translation amplitude; and showing a comparison of the baffle forces for a solid ring baffle and various perforated ring baffles. Work on determining inertia damping coefficients for mechanical models of liquid sloshing is also reported, and a simplified schematic of the test apparatus is shown. L.S.

N66-16717*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.

BUBBLE FORMATION AND GROWTH: STUDY OF THE BOUNDARY CONDITIONS AT THE BUBBLE WALL THROUGH IRREVERSIBLE THERMODYNAMICS Progress Report, 17 Feb.–30 May 1965

Arthur Shavit and Kang R. Chun Jun. 1965 76 p refs

(Contract NAS8-20013)

(NASA-CR-70023) CFSTI: HC $3.00/MF $0.75 CSCL 20D

Growth or collapse of a spherical vapor bubble in a sea of one component inviscid liquid with constant material properties was considered in the absence of force fields. Vapor was assumed to be uniform in temperature. Since mass and heat cross the discontinuity at the phase boundary, a coupling between heat and mass flux is expected with the accompanying discontinuities of temperature and chemical potential. The present study differs from previous works in the literature in its consideration of those non-equilibrium effects with the techniques of irreversible thermodynamics and kinetic theory. A new pair of differential equations to be solved simultaneously for the bubble radius behavior was developed. Improvement over previous works is expected when the bubble wall velocity reaches a very high value in the order of sonic velocity of the liquid as in the final stage of bubble collapse. Author

N66-16787 Joint Publications Research Service, Washington, D. C.

CONDITIONS FOR EXISTENCE OF CONSTANT CENTER OF PRESSURE FOR A BODY OF COMPLEX GEOMETRIC SHAPE

A. B. Ryabov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 120–123 refs (See N66-16766 07-14) CFSTI: $6.00

This paper presents the derivation of equations which define the conditions for the existence of a constant center of pressure with movement of bodies of complex geometric form in a fluid of nonuniform density. Author

N66-16822# Harvard Univ., Cambridge, Mass. Dept. of Mathematics.

SECONDARY FLOW IN A VISCOUS VORTEX

Albert I. Barcilon 22 Nov. 1965 74 p refs

(Contract Nonr-1866(34))

(AD-624580) CFSTI: HC $3.00/MF $0.75

The decay for t>0 of a potential swirling flow is studied at t=0, when a constant positive value is suddenly imposed on the kinematic viscosity. The flow at this instant is taken to be a potential vortex swirling on top of an infinite stationary horizontal plate. The fluid is assumed to have a constant density, and the flow is laminar and axially symmetric. The interaction of the axial boundary layer flow and the plate boundary layer is studied. TAB

N66-16834# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

SEPARATION OF A BINARY GAS MIXTURE BEHIND A CURVED SHOCK

Reuben R. Chow Sep. 1965 28 p refs
(RM-295; AD-471856)

Preliminary findings of a higher order curved shock theory for a chemically inert gas mixture of two species are presented. The nonvanishing separation of species behind the shock due to the existence of shock curvature is shown. Author (TAB)

N66-16940*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN ESTIMATE OF THE CHEMICAL KINETICS BEHIND NORMAL SHOCK WAVES IN MIXTURES OF CARBON DIOXIDE AND NITROGEN FOR CONDITIONS TYPICAL OF MARS ENTRY

Robert L. Mc Kenzie Washington, NASA, Feb. 1966 67 p refs
(NASA-TN-D-3287) CFSTI: HC $3.00/MF $0.75 CSCL 01A

The chemical kinetics behind normal shock waves in mixtures of carbon dioxide and nitrogen are studied. Particular emphasis is placed on a shock speed of 8 km/sec in ambient gas compositions containing 5, 10, and 50 percent CO_2 by volume. These conditions are typical of those anticipated for entry into the Martian atmosphere. Ambient density is varied from 10^{-6} to 10^{-1} times that of the earth sea-level density. The species considered are CO_2, N_2, CO, NO, CN, O_2, C, O_2, C, O, and N. A system of 17 reactions is initially assumed and later reduced to 9 by removing those found insignificant to the gross thermochemical behavior. The methods used for estimating exchange reaction rates are discussed in detail, and a scheme for correlating experimental activation energies is suggested. General features of the nonequilibrium chemistry are presented followed by an analysis of the uncertainties due to possible errors in estimated reaction rates. Particular consideration is given to the kinetics of CN for shock speeds of 4 to 8 km/sec. The CN concentration is shown to rapidly overshoot its equilibrium value for most ambient densities and shock velocities anticipated during entry into the Martian atmosphere. Author

N66-16943# Lockheed Missiles and Space Co., Sunnyvale, Calif.

SUPERSONIC FLOW AROUND BLUNT BODIES BY NONEQUILIBRIUMLY DISSOCIATING AIR

V. K. Dushin and Iv. P. Lun'kin [1965] 14 p refs Repr. from Zh. Tekh. Fiz. (Leningrad), v. 35, no. 8, 1965 p 1461–1470 refs

The supersonic flow of nonequilibriumly dissociating air around a blunt body is calculated by the integral relations method. The influence of a set of different reactions on the profiles of the gas dynamic quantities in the shock layer and on the body surface is investigated. Author

N66-16952# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE NONSTATIONARY MOTION OF A VISCOUS FLUID IN A THIN, ELASTIC CYLINDRICAL TUBE

N. A. Kil'chevskii, G. L. Komissarova, and V. S. Martynenko [1965] 9 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 11, 1965 p 1438–1442

The nonstationary motion of a viscous compressible fluid in a deformed cylindrical tube for a given law of endplate motion, which is determined by the generalized coordinates $x_1(t)$ and $x_2(t)$, where t is the time, is studied. A tube is considered for which the critical Reynolds number is large, but the ratio of the tube thickness to its diameter is small. Author

N66-16974*# Southwest Research Inst., San Antonio, Tex.

[SLOSHING STUDIES] Quarterly Progress Report No. 16, 1 Jan.–31 Mar. 1965

H. Norman Abramson 5 Apr. 1965 12 p
(Contract NAS8-1555)
(NASA-CR-70183) CFSTI: HC $1.00/MF $0.50 CSCL 20D

Progress is reported on a harmonic analysis of pressure data on ring baffles. The pressure data reduced by the peak amplitude measurement method yielded good results only for the ring section normal to the excitation amplitude. Erratic pressures at other ring sections resulted from data taken for peak pressure–force measurements. At frequencies corresponding to the peak pressure–force measurements, the liquid motion is comprised of a combination of the first anti-symmetric and symmetrical sloshing modes. The harmonic analysis results also indicated that these two modes are the dominant harmonics. Experimental force measurements for solid and perforated ring baffles indicated that the experimental force measurements on a solid ring baffle are in a range bounded by two different theoretical force computations. The experimental non-dimensional force measurement results are given as a function of baffle submergence for three values of translation amplitude. Also, a comparison of the baffle forces for a solid ring baffle and various perforated ring baffles is presented. The project to determine the significance of the moment of inertia damping when the tank is excited in pitching motion is also discussed. E.E.B.

N66-16984*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

STAGNATION POINT FLOW WITH RADIATION

R. F. Chisnell, H. Hoshizaki, and L. E. Lasher Oct. 1965 44 p refs
(Contract NAS7-295)
(NASA-CR-70171; LMSC-4-43-65-4) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The coupling between the inviscid and viscous flows in the hypersonic stagnation region is investigated at high flight velocities where radiative energy transport is significant. A simple analytic solution for the flow field is found, in which the velocity field is expressed in terms of the density and two position coordinates. Solutions to the energy equation were obtained, including radiation transport for a gray gas, using the analytic flow field solution. The results of the analysis show that under some conditions, the reduction in the convective heating due to radiation cooling can be predicted by an inviscid flow analysis. It is also concluded that second-order boundary-layer effects do not play an important role in radiatively coupled flow fields. Author

N66-17004# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF A LAMINAR BOUNDARY LAYER FOR SUBLIMABLE SURFACE

V. V. Shchennikov 19 Nov. 1965 26 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 1, no. 5, 1961 p 869–883
(FTD-MT-65-10; AD-624761) CFSTI: HC $2.00/MF $0.50

The work is devoted to the problem of the calculation of a laminar boundary layer near sublimable axially symmetric blunt body, moving at a great supersonic speed. There are

obtained equations and boundary conditions of the problem. The high temperature in boundary layer causes the presence of chemical reactions. The method of calculating the stationary flow near the critical point of a blunt axially symmetric sublimable body, whose temperature and pressure satisfy either the condition of phase transition, or condition of evaporation is presented. The assumption as to the stationarity of the flow is justified by the following considerations. It is possible to present a special body, which in sublimating repeats its own shape. On the other hand, for any smooth body this assumption has substiantiation when the speed of the sublimation is much less than the speed of the oncoming flow. The obtained numerical results for the case of a body consisting of graphite flowed around by oxygen where the chemical reactions occurring in the boundary layer are assumed to be equilibrium.
Author

N66-17112*# Pittsburgh Univ., Pa. Space Research Coordination Center.
FLOW SEPARATION AND REATTACHMENT IN AN UNEQUAL ELBOW
R. K. Duggins 15 Jul. 1965 31 p refs
(Grant NsG-416)
(NASA-CR-70338; SRCC-10) CFSTI: HC $2.00/MF $0.50
CSCL 20D

A theoretical analysis of a flow separation problem is presented for the case in which flow occurring in an unequal elbow separates and then reattaches the detached stream to form a closed wake containing a standing eddy. An assumption regarding the vorticity distribution is made, and empirical data are used to establish the length of the wake. Attention was focused on the particular conditions of large Reynolds number R, for which the pattern and mechanism of flow are stable and insensitive to changes in R. Good agreement was obtained between the calculated and the experimentally observed flow patterns in the elbow configuration; and it is anticipated that the analytical method will be equally successful if applied to other flow configurations in which separation occurs in a contracting stream.
L.S.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N66-16185*# Alaska Univ., College. Geophysical Inst.
EFFECTIVE RECOMBINATION COEFFICIENT IN D-REGION Scientific Report No. 1
R. Parthasarathy and D. B. Rai Sep. 1965 41 p refs
(Contract NAS5-3595)
(NASA-CR-69892; UAG-R171) CFSTI: HC $2.00/MF $0.50
CSCL 04A

The effect of the meteoric dust particles on the steady state distribution of electrons and ions in the lower ionosphere (50–90 km) has been investigated. It is shown that the effective recombination coefficient obtained is higher than that obtained by ignoring the presence of dust. The expression for the effective recombination coefficient thus obtained is of the form

$$\alpha_{eff} = (\alpha_d + \lambda\alpha_i)(\eta + \gamma\lambda) + \frac{D_e + \lambda D^-}{N_e}$$

where D_e, D^+ and D^- are the dust capture coefficients for electrons, positive ions and negative ions respectively; η and γ are the ratios D_e/D^+ and D^-/D^+ respectively. The recombination coefficients for the region 50–90 km are in agreement with those deduced empirically by us from the multiple frequency (5–50 Mc/s) radiowave absorption data in the auroral zone. The empirical method consisted of comparing the electron density profile derived from the multiple frequency radiowave absorption with the ionization rate profile calculated using satellite-measured particle flux.
Author

N66-16207# Hebrew Univ., Jerusalem (Israel). Dept. of Meteorology.
NUMERICAL STUDIES OF PLANETARY CIRCULATIONS IN A MODEL ATMOSPHERE Final Report
Abraham Huss Bedford, Mass., AFCRL, Aug. 1965 127 p refs
(Grant AF-EOAR-64-76)
(AFCRL-65-771; AD-623662) CFSTI: HC $4.00/MF $0.75

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2. PRELIMINARY INTEGRATIONS OF A TWO-LEVEL QUASI-GEOSTROPHIC MODEL INCLUDING WATER-VAPOR A. Huss and E. Doron 58 p refs (See N66-16209 07-13)

N66-16208 Hebrew Univ., Jerusalem (Israel). Dept. of Meteorology.
NUMERICAL INTEGRATIONS OF A TWO-LEVEL QUASI-GEOSTROPHIC MODEL INCLUDING DIABATIC HEATING AND SURFACE FRICTION
Abraham Huss *In its* Numerical Studies of Planetary Circulations in a Model Atmosphere Aug. 1965 59 p refs (See N66-16207 07-13) CFSTI: HC $4.00/MF $0.75

The evolution of general circulation patterns has been studied by means of a two-level quasi-geostrophic model including diabatic heating and surface friction. Results are shown for integrations over a period of about 30 days. The Jacobian representing the advection of potential vorticity in the prognostic equations was approximated in two ways: once by the 4-point conventional finite difference analog and once by energy-consistent analog. The distributions of various field-variables were found to resemble the corresponding distributions in the atmosphere, as far as patterns and magnitudes were concerned. Use of the energy-consistent Jacobian resulted in a lower noise level at the conclusion of the run, in higher zonal velocities, in lower energy transformations (except for the $[K,\bar{K}]$ transform), and in a more pronounced oscillatory evolution of various field variables.
Author

N66-16209 Hebrew Univ., Jerusalem (Israel). Dept. of Meteorology.
PRELIMINARY INTEGRATIONS OF A TWO-LEVEL QUASI-GEOSTROPHIC MODEL INCLUDING WATER-VAPOR
Abraham Huss and Eliyahu Doron *In its* Numerical Studies of Planetary Circulations in a Model Atmosphere Aug. 1965 58 p refs (See N66-16207 07-13) CFSTI: HC $4.00/MF $0.75

Water-vapor was introduced into a two-level quasi-geostrophic model. The local change of the specific humidity was predicted by means of a continuity equation for the water vapor. Changes due to evaporation from the lower boundary (assumed to be an ocean surface) and to precipitation were taken into account. Several integrations were performed with different initial distributions of the specific humidity. In the first series of runs the flow pattern was assumed to develop without being affected by the release of latent heat. In the two last

experiments latent heat was introduced into the thermodynamic energy equation. A rapid rise of the noise level was observed in these cases and the integration had to be interrupted after the passage of a few days. Author

N66-16240 Joint Publications Research Service, Washington, D. C.
NEW COMPUTATION OF THE HEAT BALANCE OF THE EARTH-ATMOSPHERE SYSTEM
K. Ya. Vinnikov *In its* Recent Develop. in Meteorology and Hydrology 19 Nov. 1965 p 13–23 refs (See N66-16238 07-13) CFSTI: $3.00

The method of computation of the heat balance of the earth-atmosphere system is presented and the principal laws of the spatial distribution of the mean long-range annual values of the principal components of the heat balance of the earth-atmosphere system are discussed. Mean annual latitude values of the components of the heat balance of the earth-atmosphere system are tabulated. E.E.B.

N66-16242 Joint Publications Research Service, Washington, D. C.
INTERNATIONAL HYDROLOGICAL SURVEY OF THE BALTIC SEA
B. A. Filippov *In its* Recent Develop. in Meteorology and Hydrology 19 Nov. 1965 p 35–37 (See N66-16238 07-13) CFSTI: $3.00

The Fourth Conference of Oceanographers of the Baltic Sea is discussed. The basic content of the program adopted by this conference was as follows: (1) a complex of prolonged and synchronized hydrometeorological measurements at earlier selected points of the sea using automatic buoy stations or ships at anchor for this purpose; (2) work on hydrological profiles covering the entire water surface of the Baltic Sea; and (3) observations at shore hydrometeorological stations with frequent measurements of water level, wind and water temperature. A sketch map is presented showing hydrological profiles, multiday buoy stations and observations from ships, and shore hydrometeorological stations. Ships from the Soviet Union, Poland, Sweden, Finland, and West Germany participated in the Baltic Sea Area survey. E.E.B.

N66-16261# Joint Publications Research Service, Washington, D. C.
STUDY OF SEISMIC WAVES TO DETERMINE STRUCTURE OF EARTH'S CRUST
A. V. Kozlov et al 3 Feb. 1966 29 p refs Transl. into ENGLISH from Sb. Statey po Seysmologii (USSR), v. 12, 1964 p 31–42, 54–66
(JPRS-33988; TT-66-30431) CFSTI: $1.00

The paper deals with some comparative results of theoretical and experimental dynamic characteristics of seismic waves. A conclusion is drawn regarding the lack of thick layers with lower velocity within the Earth's crust of the region under study. From the results of comparing the theoretical and experimental amplitude curves, it is concluded that there is absorption of the seismic waves within the earth's crust; the upper limit of the absorption coefficient is given. Author

N66-16284*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
A SUBSONIC D-REGION PROBE-THEORY AND INSTRUMENTATION Scientific Report No. 247
L. C. Hale and D. P. Hoult 31 Aug. 1965 48 p refs
(Grants NsG-134-61; DA-ARO-D-31-124-G659)
(NASA-CR-69823) CFSTI: HC $2.00/MF $0.50 CSCL 04A

The philosophy, theory, and a description of the instrumentation of a subsonic, D-region ion and electron probe are presented. It is shown theoretically that a blunt, high potential, parachute borne probe collects charged particles according to a simple, angle of attack independent, mobility theory. This theory has been substantiated experimentally with payloads launched on Arcas rockets. The design of these payloads, which include a range-switching electrometer and low-cost telemetry system, is discussed in detail. Author

N66-16314# Michigan Univ., Ann Arbor. Geophysics Lab.
DISPERSION TABLES FOR RAYLEIGH WAVES ON A SINGLE SURFACE LAYER VESIAC Special Report
Harold M. Mooney (Minnesota Univ.) and Bruce A. Bolt (California Univ., Berkeley) Oct. 1965 213 p refs
(Contract ARPA SD-78; Grant AF-AFOSR-62-411)
(Rept.-4410-102-X; AD-473363)

Tables are presented to show the dispersive characteristics for Rayleigh waves on a single elastic layer overlying a uniform elastic half-space. Two standard models are considered, each specified in terms of four parameters: Poisson's ratio in the layer and in the half-space, and the shear velocity and density ratios. Each parameter is varied through eight values, holding the other three parameters constant. For each such structure, results are given for the fundamental Rayleigh mode and the first and second shear modes. The tables consist of 32 cases, for each of three modes, for each of the two standard models, or a total of 192 tables. A special computation procedure for group velocities is used which eliminates the errors associated with the usual finite-difference approximation. Auxiliary information includes a tabulation of long-period cutoff values as a function of structure parameters. To illustrate the results for specific geologic and laboratory models, 36 additional tables are given. These include results for a continental ice cap, a continental crust, a sedimentary basin, an alluvial overburden, various two- and three-dimensional seismic models, and a case selected from the literature. Author (TAB)

N66-16371 Joint Publications Research Service, Washington, D. C.
VERTICAL OZONE DISTRIBUTION IN THE EARTH'S ATMOSPHERE
R. D. Bozhkov *In its* Studies in Meteorology and Hydrol. (No. 10, 1965) 9 Dec. 1965 p 1–13a refs (See N66-16370 07-20) CFSTI: $3.00

The mean annual vertical distribution of ozone in nine atmospheric layers was studied by computation of available observational data covering the years 1956 through 1963. Ozone isolines were drawn in micromillibars for the ratio of partial pressure to approximate ozone density. Layers with maximum ozone density had a mean height of 26 km from the equator to the subtropics and decreased then to 24 and 23 km over the temperate latitudes. Data on the change of ozone confirmed the presence of meridional transports directed poleward in the middle stratosphere, mostly in winter and spring. Summer and autumn meridional transport was attenuated and sometimes directed from the pole to the equator. G.G.

N66-16372 Joint Publications Research Service, Washington, D. C.

COORDINATE-DOPPLER METHOD OF WIND OBSERVATIONS AND SOME RESULTS OF INVESTIGATION OF WIND FIELD HETEROGENEITIES IN ATMOSPHERE

A. G. Gorelik, V. V. Kostarev, and A. A. Chernikov *In its* Studies in Meteorology and Hydrol. (No. 10, 1965) 9 Dec. 1965 p 14–26 refs (See N66-16370 07-20) CFSTI: $3.00

A pulsed coherent radar was augmented with special auxiliary devices to record Doppler frequency shifts, induced by atmospheric turbulences, during the tracking of a falling corner reflector. Data for mean gradients of 250 m layers were used to determine the distribution of possible wind gradients. Comparison of wind profiles obtained by this coordinated Doppler method with those found by ordinary coordinate measurements established the considerably greater detail of the Doppler observations. G.G.

N66-16381*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

THE DYNAMICS OF THE AURORA. PART VII: EQUATORWARD MOTIONS AND THE MULTIPLICITY OF AURORAL ARCS

S.-I. Akasofu, D. S. Kimball, and C.-I. Meng (Alaska Univ.) Dec. 1965 25 p refs

(Grants Nsg-201-62; NsG-233-62; NSF GP-2721)

(NASA-CR-69874) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Equatorward motions of auroras are described in detail as follows: (1) the equatorward shift associated with the earth's rotation; (2) the equatorward motion during the recovery phase of the auroral substorm; and (3) the equatorward spread of irregular bands during the substorm. The multiplicity of arcs associated with the equatorward motion is also described. Author

N66-16385*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

THE DEVELOPMENT OF THE FORBUSH DECREASE AND THE GEOMAGNETIC STORM FIELDS

S. Yoshida and S.-I. Akasofu (Alaska Univ.) Dec. 1965 28 p refs *Its* Rept.-65-41

(Grants NsG-201-62; NsG-233-62)

(NASA-CR-69871) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Relationships between the development of Forbush decreases and characteristics of associated geomagnetic storm fields are examined. It is shown that the onset of a significant Forbush decrease is more closely related to the development of successive sudden impulses or world-wide geomagnetic micropulsations during geomagnetic storms than to a simple step function-like storm sudden commencement. The magnitude of the main phase decrease shows no obvious relation with the magnitude of the Forbush decrease. Author

N66-16393*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

THE AURORAL OVAL, THE AURORAL SUBSTORM, AND THEIR RELATIONS WITH THE INTERNAL STRUCTURE OF THE MAGNETOSPHERE

Syun-Ichi Akasofu (Alaska Univ.) Nov. 1965 49 p refs *Its* Rept.-65-37

(Grants NsG-201; NsG-233; NSF GP-2721)

(NASA-CR-69872) CFSTI: HC $2.00/MF $0.50 CSCL 04A

If the neutral sheet is the source region of auroral particles, they flow from the neutral sheet towards the earth and produce an oval-shape glow on the polar ionosphere, which we identify as the auroral oval. The auroral oval shows two major changes during geomagnetic storms; the expansion of the oval as a whole (the equatorward shift), and transient and repeated expansions and subsequent contractions of width, particularly in the midnight sector (the auroral substorm). The equatorward shift can reasonably be explained by the change of the internal structure of the magnetosphere resulting from the growth of the ring current and the neutral sheet current, and the interaction of these two systems. An attempt is made to explain the auroral substorm as a manifestation of imbalance of the two systems. The conservation of angular momentum suggests that the hot plasma flowing toward the ionosphere acquires a greater eastward speed than that of the earth's rotation. The interaction between this flow and the neutral atmosphere generates the polar electrojet. Author

N66-16413# Boeing Scientific Research Labs., Seattle, Wash.

PHYSICS OF THE SEISMIC SOURCE

E. Orowan Sep. 1965 49 p refs

(D1-82-0471; AD-623875) CFSTI: HC $2.00/MF $0.50

The 'fault source' and the 'double-couple source' are discussed as possible mechanisms of seismic shock generation. TAB

N66-16466# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

WORLD MAPS OF ISOPORS FOR THE PERIOD OF 1954–1959 [MIROVYYE KARTY IZOPOR DLYA PERIODA 1954–1959 GODOV]

N. V. Adam and V. P. Orlov Sep. 1965 18 p refs Transl. into ENGLISH from Vopr. Zemnogo Magnetizma, Akad. Nauk SSSR (Moscow), Issue 18, no. 28, 1961 p 14–26

(TC-942; AD-623437) CFSTI: HC $1.00/MF $0.50

A compilation of world maps containing isopors are presented for the period 1954 to 1959. Data for these maps are based on the results of observations conducted by a world network of magnetic observatories. The maps are of use for both practical purposes of magnetic cartography and for research works in the field of terrestrial magnetism, which in any case are connected with the value of δF. Maps of secular variation are given for the three elements of the earth's magnetic field D, H, and Z in a central azimuthal projection, separately for the southern and northern hemispheres, and for the zone of 70° north to 50° south latitude in a mercator projection. Methods and techniques used in compiling the data are also discussed. M.R.W.

N66-16479# Joint Publications Research Service, Washington, D. C.

SOVIET STUDIES IN THE EARTH SCIENCES

B. I. Silkin et al 27 Dec. 1965 50 p Transl. into ENGLISH from Zemlya Vselennaya (Moscow), no. 5, Sep.–Oct. 1965

(JPRS-33478; TT-65-34052) CFSTI: $2.00

Presented are four articles on: the international year of the quiet sun—a study of the numerous and close connections between the behavior of the sun and the physical processes embracing the earth; the rift system of the earth—an investigation of the deep cracks in the earth's crust; oceanography studies using deep-water photography; and the Gulf Stream. M.R.W.

N66-16558*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

WIND LOADS ON VERTICALLY LAUNCHED VEHICLES AT VARIOUS GEOGRAPHIC LOCATIONS AND LAUNCH ALTITUDES

Robert M. Henry and James A. Cochrane Washington, NASA, Feb. 1966 18 p refs
(NASA-TN-D-3271) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Methods of determining possible alternate launch sites that offer distinct advantages in wind conditions over presently used sites are discussed; reductions of 50 percent or more in statistically determined peak winds or in statistical values of wind shears at critical altitudes may be realized. Since peak winds and maximum shears are recognized parameters of wind-induced loading, the variations in peak loads that are expected at different launch sites should reflect significant changes in wind environment with geographical regions. For some particular vehicles, variation of a single parameter, such as maximum wind speed, will produce large differences in computed load histories. A simulated liquid-propellant-vehicle system was subjected to various wind inputs. The peaks of the load histories for this particular vehicle appear more strongly related to maximum wind shears than to maximum wind speed. Simulated vehicle flights from high-altitude launch sites were studied. Only small variations in maximum vehicle loading result from changes in launch altitudes below 10000 feet (3 kilometers), because the reduction in maximum dynamic pressure was principally offset by an increased rigid-body angle of attack. Author

N66-16605*# Utah Univ., Salt Lake City. Upper Air Research Lab.
FALLING SPHERE-RADAR MATHEMATICAL SIMULATION TECHNIQUES Final Report, 15 Dec.–15 Aug. 1965
Forrest L. Staffanson and Kenneth E. Phillips [1965] 80 p refs
(Grant NGR-45-003-016)
(NASA-CR-70144) CFSTI: HC $3.00/MF $0.75 CSCL 04A

A computer program using Fortran IV is developed which describes the translational motion of a meteorological sphere falling through the upper atmosphere. The sphere is assumed a point mass, acted upon by drag, gravity and buoyancy forces. Influence of virtual mass, coriolis and centripetal accelerations are included. The program requires molecular temperature, initial pressure, local mean sea-level gravity and drag coefficients as input quantities. The output includes position and time data and 24 other variables associated with the sphere flight. An example illustrating the response of a light sphere to horizontal winds with varying wind layer thickness is presented. The second part describes a computer program which converts the simulated sphere trajectory into simulated tracking radar data, including radar errors. The results of a preliminary study of an oscillatory error in real ROBIN data is appended. Author

N66-16642# RAND Corp., Santa Monica, Calif.
A SURVEY OF MAGNETIC STORMS
E. H. Vestine Dec. 1965 17 p refs Presented at the Natl. Bur. of Std., Boulder, Colo., 14–16 Apr. 1965 Submitted for Publication
(P-3270; AD-624776) CFSTI: HC $1.00/MF $0.50

Our knowledge of magnetic storms is briefly summarized. They arise from phenomena associated with the impact upon the geomagnetic field of streaming solar particles. The outer geomagnetic field is distorted by the solar wind into a configuration resembling the tail of a comet, with the earth as nucleus. Secondary phenomena in the trailing tail, probably, are important in causing associated phenomena such as the aurora and ionospheric storms, but the causative processes involved are not understood. TAB

N66-16646# RAND Corp., Santa Monica, Calif.
PHOTOCHEMICAL DESTABILIZATION OF GRAVITY WAVES NEAR THE MESOPAUSE
C. B. Leovy Nov. 1965 45 p refs
(Contract AF 49(638)-66-C-0001; Proj. RAND)
(RM-4818-PR; AD-625011) CFSTI: HC $2.00/MF $0.50

A number of possible interaction mechanisms between internal gravity waves and radiative and photochemical processes at altitudes from 80 to 120 km are considered. The heat of recombination of atomic oxygen and absorption of solar radiation by ozone are both found to contribute to wave amplification. Growth rates are slow under normal conditions but can become significant if the atomic oxygen concentration below 100 km is increased above its normal values. This could be brought about by large-scale descending motion or by increased mixing near the mesopause. Author (TAB)

N66-16651# Technology, Inc., Dayton, Ohio.
MEASUREMENT OF WIND SHEAR First Quarterly Report, 15 Dec. 1964–16 Mar. 1965
N. S. Phillips, T. W. Temple, and M. C. Eifert Nov. 1965 47 p refs
(Contract DA-28-043-AMC-00384(E))
(ECOM-00384-1; AD-625335) CFSTI: HC $2.00/MF $0.50

Several mathematical models were developed to analytically explain the outputs from the wind shear probe accelerometers and magnetic aspect sensor. The methods developed were then applied to samples of recorded data to determine the effects of the various parameters upon calculated output. The results were neither consistent nor conclusive. The models developed considering small time interval approximations were too dependent upon reading accuracy. Additional work was directed toward improving the capability of the instrumentation system of the probe. Some temperature testing was conducted and circuit modifications and battery requirements were finalized. Modifications to the probe configuration were made to eliminate problem areas uncovered during the flight testing program. These were incorporated into the design and have been included in the probes under construction. Author (TAB)

N66-16673# Deutscher Wetterdienst, Offenbach am Main (West Germany).
THE NULL LAYER CONCEPTION IN STRATOSPHERE AND MESOSPHERE, ESPECIALLY IN SPRING AND FALL
Heinrich Faust Jan. 1963 29 p refs
(Contract DA-91-591-EUC-2174)
(SR-1; AD-625216)

'Null layer' refers to a persistent layer of extreme wind which has the characteristic quality of reversing a large scale vertical motion. TAB

N66-16680# Acadia Univ., Wolfville (Nova Scotia).
RADAR AND GEOLOGY Final Report, Feb. 1964–Feb. 1965
Harcourt L. Cameron 23 Jul. 1965
(Contract AF 19(628)-4005)
(AFCRL-65-202; AD-624887)

The topographic mapping possibilities of radar have been investigated almost since radar was developed. The geological interpretation of P.P.I. scope photography is discussed with possible explanations for the geological expression of certain features. The example of radar ice mapping is given and the radar geology of part of Eastern Canada described. The radar geology of Scotland is briefly described. The application of radar photography to the study of geological structures is recommended as a new and possibly unique method. Author (TAB)

N66-16687*# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.

THE INVESTIGATIONS OF THE TEMPERATURE AND SPECTRAL EMISSIVITY CHARACTERISTICS OF CLOUD TOPS AND OF THE EARTH'S SURFACE Second Semi-annual Progress Report

William E. Marlatt Dec. 1965 32 p *Its* Tech. Paper No. 72 (Contract NASr-147)

(NASA-CR-70053) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Progress is reported on an investigation to (1) study the relationship between actual surface temperature and cloud-top temperatures, and the temperatures of these surfaces as measured by radiometers from aircraft, balloon, and meteorological satellites; and (2) analyze spectral characteristics of various cloud types and the surface of the earth in desert, grassland, and forested areas. Measurements of surface temperatures over the Pawnee National Grassland were conducted using thermistors, and ground-based and air-based radiometers. Measurements of albedo and of clouds, ocean surfaces and various earth surfaces were obtained using the TIROS radiometer and the sol-a-meters. Measurements of desert and ground radiation and temperatures were obtained near Edwards Air Force Base, California, in conjunction with flights conducted by the CARDE Project and the University of Michigan. Ocean and grassland-surface temperature measurements were obtained for several orbits immediately following the launching of NIMBUS I. A few measurements of cloud-top radiation temperatures were obtained for comparison with air temperatures. M.R.W.

N66-16691# Pennsylvania State Univ., University Park. Dept. of Meteorology.

OBJECTIVE CROSS-SECTION ANALYSIS Final Report, Part II, Mar. 22, 1960–Dec. 31, 1963

R. T. Duquet, E. F. Danielsen, and N. R. Phares Dec. 1964 39 p refs

(Contract AF 19(604)-7261)

(AFCRL-64-1005, Pt. II; AD-625137) CFSTI: HC $2.00/MF $0.50

The distribution of wind and of temperature in a vertical cross section through the atmosphere is derived from radiosonde and rawinsonde data by an objective analysis procedure suitable for automatic computers. The method of interpolation takes advantage of the fact that soundings in the plane of the cross section provide data along vertical lines rather than at randomly distributed points. The thermal wind equation is used to modify the interpolated distribution through a partial differential equation derived from the calculus of variations. Results indicate that the technique is capable of delineating not only the gross vertical structure of the atmosphere but also some significant layers of high stability and/or potential vorticity which are inadequately defined by analyses in quasi-horizontal planes at the standard pressure levels. Author (TAB)

N66-16713*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

THE AURORAL OVAL, THE AURORAL SUBSTORM, AND THEIR RELATIONS WITH THE INTERNAL STRUCTURE OF THE MAGNETOSPHERE

Syun-Ichi Akasofu (Alaska Univ.) Nov. 1965 49 p refs Prepared jointly with Alaska Univ. *Its* Rept.-65-37

(Grants NsG-201-62; NsG-233-62; NSF GP-2721)

(NASA-CR-70030) CFSTI: HC $2.00/MF $0.50 CSCL 04A

The concept of the auroral oval is described, and the use of the concept in relating the oval and the substorms occurring within it to the internal structure of the magnetosphere is discussed. The equatorward shift of the oval can reasonably be explained by the change of the internal structure of the magnetosphere resulting from the growth of the ring current and the neutral sheet current. The interaction of these two systems delimits the boundary between the trapping region and the tail region of the magnetosphere in the dark side. Schematic drawings of the oval under various conditions are given. An attempt is also made to explain the major feature of the auroral substorm as a manifestation of transient imbalance of the two current systems. If a sudden decrease of the neutral sheet current occurs, this process closes some of the field lines which had been open previously by the two systems; first the field line closest to the outer boundary of the trapping region, and then those which anchor in higher latitudes. It is suggested that this is manifested by the explosive phase of the auroral substorm during which active auroral bands move rapidly polewards. As soon as the neutral sheet current begins to resume its intensity, the opposite process takes place and the recovery phase starts; the auroras begin to move toward their initial location. L.S.

N66-16714*# Electro-Optical Systems, Inc., Pasadena, Calif.

ULTRA-HIGH ALTITUDE MEASUREMENT SYSTEMS FOR PRESSURE, DENSITY, TEMPERATURE, AND WINDS Final Report, Feb.–Nov. 1963

Glenn A. Cato 15 Jan. 1964 173 p refs

(Contract NAS8-5226)

(NASA-CR-70020; EOS-3780-Final) CFSTI: HC $5.00/MF $1.00 CSCL 04A

Methods of measuring the properties of the free atmosphere from on board a large launch vehicle such as Saturn are evaluated. The properties to be measured are pressure, temperature, density and wind of the undisturbed atmosphere above 30 km. Measurement techniques and instrumentation are recommended for each property with special emphasis on remote measurement techniques, wherein the instrument is located aboard the vehicle but the measurement actually is made beyond the shock layer. Author

N66-16720*# Michigan Univ., Ann Arbor. Space Physics Research Lab.

MEASUREMENT OF THE EARTH'S ATMOSPHERE Final Report

D. R. Taeusch and A. F. Nagy Nov. 1965 23 p refs *Its* Rept-04673-6-F

(Contract NASr-54(01))

(NASA-CR-70019) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Ambient pressure, temperature, and density data for the earth's atmosphere over Wallops Island, Virginia were measured by instrumentation aboard rocket probes. The data are plotted, and given in tabular form. The design of the pitot-static probe, capable of using radioactive ionization gauges, rather than diaphragm gauges for the transducers, is illustrated. The probe contains three densatron units; one for impact or pitot pressure measurement; one for the ambient or static pressure measurement; and one for measuring the roll modulated pressure (for atmospheric wind determination). Other instrumentation included a magnetometer and optical sun–earth aspect sensor for aspect determination, a TM transmitter and a transponder. L.S.

N66-16806# Joint Publications Research Service, Washington, D. C.

CURRENT CONDITIONS OF THE STUDY OF GEOMECHANICS

Tien-Ch'ing Sun and Ch'ing-Hsuan Chen *In its* Transls. on Communist China's Sci. and Technol. 17 Jan. 1966 p 20–38 ref (See N66-16806 17-34) CFSTI: HC $6.00

In geomechanics, concepts and methods of mechanics are used to analyze and study phenomena of geological structure. Experimental analyses and electro-plastic theories were utilized to investigate the mechanical causes of various types of geological faults in China, the possible depth caused by faulting and its nature, the condition of its origin, and the amount of relative motion which changes in accordance with depth. Analysis of the tectonic systems in China established: (1) The east–west complicated tectonic zone; (2) the north–south tectonic zone with its independent structure frequently appearing at fold rifts; and (3) the various Rhaetic tectonic forms of rotary structures. A short outline of research activities in rock mechanics, active earth stress, and earth crust movements is included. G.G.

N66-16951# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.
A PROVEN CASE OF (GEOMAGNETIC) FIELD INVERSION
O. A. Mandrusova and G. N. Petrova Dec. 1965 14 p refs Transl. into ENGLISH from the book "Rock Magnetism and Paleomagnetism" Krasnoyarsk, Siberian Div. of the Acad. of Sci., 1963 p 447–456 CFSTI: HC $1.00/MF $0.50

A collection of samples, including two normal and one inversed magnetization horizon, from the Shkotovo basalt plateau is analyzed. Destruction-field intensity is found to be the same for all three horizons; and the natural magnetization shows a systematic decrease from younger to older horizons. The rocks analyzed are magnetically stable. Data indicate that all three horizons have magnetization of thermoremanent origin and do not differ in ferromagnetic fraction. From the direction of magnetization, the first horizon is considered to be the boundary between the Pliocene and Quaternary periods. A direct proof of this boundary is presented as the best indication of geomagnetic field inversion. M.W.R.

N66-16978*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
ON THE LOW LATITUDE 'NEGATIVE BAYS' IN THE AFTERNOON SECTOR
Syun-ichi Akasofu (Alaska Univ.) Nov. 1965 19 p refs *Its* Rept.-65-35
(Grants NsG-201-62; NSF GP-272-1; Contract Nonr-1509(06)) (NASA-CR-70189) CFSTI: HC $1.00/MF $0.50 CSCL 04A

It is argued that the so-called low latitude negative bay in the afternoon sector is not caused by the return current from the polar electrojet, but is the field of the simultaneously growing asymmetric main phase decrease. Author

N66-17036# Naval Ordnance Test Station, China Lake, Calif.
OFFSHORE GRAVITY AND MAGNETIC ANOMALIES IN THE SANTA BARBARA CHANNEL, CALIFORNIA.
Roland von Huene and James B. Ridlon Dec. 1965 58 p refs (NAVWEPS-8961; NOTS-TP-3917; AD-624700) CFSTI: HC $3.00/MF $0.75

Gravity measurements were made in the Channel with a LaCoste–Romberg surface-ship gravity meter on four cruises. Total intensity magnetic measurements were made simultaneously with a Varian-proton-precession-marine magnetometer on three of the cruises. The data are contoured to yield free-air and Bouguer gravity anomaly maps. A westward extension of the Ventura Basin parallel to the coast between Santa Barbara and Point Conception is implied by a large elongate gravity minimum, which is flanked by a gravity maximum coinciding with the Channel Islands continuous with the Santa Monica Mountains. A gravity and magnetic ridge with a Coast Ranges trend almost crosses the Channel. Author

N66-17048*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM, VOLUME B. PART II: GEOLOGY/HYDROLOGY
21 Feb. 1966 153 p refs
(Contract NASw-1215)
(NASA-CR-70358) CFSTI: HC $4.00/MF $1.00 CSCL 08H

An application to the geology/hydrology area of a framework for synthesizing an experiment program for Orbiting Research Laboratories (ORL) is illustrated. The object of this area is to enhance utilization of fuel, minerals, and water resources and to contain adverse effects of dynamic geologic/hydrologic occurrences. Consideration is given to background material which includes discussions of minerals, fuels, and water resources; identification of selected knowledge requirements; and derivations of experiment requirements. These include equipment functional and supporting research requirements, and prospective orbital activities. Illustrative selected knowledge requirements and discussions of representative experiments are appended. C.T.C.

N66-17049*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM, VOLUME B. PART III: OCEANOGRAPHY/MARINE TECHNOLOGY
21 Feb. 1966 121 p refs
(Contract NASw-1215)
(NASA-CR-70348) CFSTI: HC $4.00/MF $1.00 CSCL 08J

An application of a previously derived synthesis framework to constructing an Orbital Research Laboratory (ORL) experiment program in support of oceanography/marine technology is illustrated. The objective of this area is to exploit the resources of the ocean and to contain its adverse effects. Consideration is given to background material which includes discussions of food resources, mineral resources, ocean transportation, and the ocean as a sink for the world's wastes; identification of selected knowledge requirements; and derivations of experiment requirements. These include equipment functional and supporting research requirements, and prospective orbital activities. Illustrative selected knowledge requirements and discussions of representative experiments are appended. C.T.C.

N66-17050*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM, VOLUME B. PART IV: GEOGRAPHY
21 Feb. 1966 128 p
(Contract NASw-1215)
(NASA-CR-70349) CFSTI: HC $4.00/MF $1.00 CSCL 08F

A study report is presented which illustrates the application to the geography area of a framework for synthesizing an experiment program for Orbiting Research Laboratories (ORL). The objective of this area is to foster effective utilization of the earth's resources through improved understanding of interactions between man and his environment. Consideration is given to the identification of selected knowledge requirements and the derivation of experiment requirements. These include equipment functional and supporting research requirements, and prospective orbital activities. Appendices include illustrations and identifications of knowledge requirements, and discussions of representative experiments. C.T.C.

N66-17051*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM, VOLUME B. PART V: ATMOSPHERIC SCIENCE AND TECHNOLOGY
21 Feb. 1966 158 p refs
(Contract NASw-1215)
(NASA-CR-70342) CFSTI: HC $4.00/MF $1.00 CSCL 04A

Relative to synthesizing an experiment program for Orbital Research Laboratories (ORLs), an illustration is given of the application of the synthesis approach to the atmospheric science and technology area. The objective of this area is to enhance the prediction, modification, and control of atmospheric processes. Consideration is given to background material which includes discussions of meteorological disaster warnings, weather forecasting, weather modification, air pollution, and remote sensing; identification of selected knowledge requirements; and derivations of experiment requirements. The derivations include equipment functional and supporting research requirements, and prospective orbital activities. Illustrative selected knowledge requirements and discussions of representative experiments are appended. C.T.C.

N66-17061*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM, VOLUME C. ANNEX I: GUIDELINES FOR COMPREHENSIVE FLIGHT PROGRAM
21 Feb. 1966 168 p ref
(Contract NASw-1215)
(NASA-CR-70341) CFSTI: HC $4.00/MF $1.00 CSCL 08

Presented is a compilation of representative experiments to be conducted with the Orbital Research Laboratory (ORL). These experiments are to be made relative to the following general areas: agriculture/forestry; geology/hydrology; oceanography/marine technology; geography; atmospheric science and technology; and communications and navigation/traffic control. Included with each proposed experiment are a discussion of the objectives, expected results, the relation to other experiments, a description of the experiment, mission and orbital characteristics, and astronaut involvement. C.T.C.

N66-17080*# Northrop Space Labs., Hawthorne, Calif.
DEVELOPMENT OF TECHNOLOGICAL CONCEPTS LEADING TO BENEFICIAL USE OF LUNAR MAGMA PRODUCTS Third Quarterly Technical Progress Report, Oct.–Dec. 1965
E. Azmon [1965] 9 p
(Contract NAS7-358)
(NASA-CR-70307) CFSTI: HC $1.00/MF $0.50 CSCL 08G

It is reported that 110 determinations were made of the solid liquid phase transformations of igneous rocks from pressures of one atmosphere to 45 kilobars. These examinations were conducted on the Hugoton meteorite, tholeiitic basalt, granodiorite, and serpentine. Emphasis was placed on investigating crystalline stability regions of serpentine by means of X-ray diffraction analyses. C.T.C.

N66-17096*# Geophysics Corp. of America, Bedford, Mass.
MEASUREMENTS IN THE IONOSPHERE DURING A SOLAR ECLIPSE Final Report
L. G. Smith, L. H. Weeks, C. A. Accardo, and P. J. Mc Kinnon
Aug. 1964 109 p refs
(Contract NASw-500)
(NASA-CR-70324; GCA-TR-64-14-N) CFSTI: HC $4.00/MF $0.75 CSCL 04A

The behavior of the ionosphere up to 200 km was observed in a series of rocket flights during the solar eclipse of 20 July 1963. Six Nike Apache rockets were instrumented to measure electron density, electron temperature, Lyman-α radiation and a band of X-rays (44–60Å). The electron density in the E-region (90–160 km) was reduced during the eclipse without any significant change in the shape of the profile. The rocket data show a time lag between the minimum area of the visible solar disc and the minimum electron density of much less than 3 minutes. Comparison with ionosonde data indicates a minimum value of 1×10^{-7} cm^3 sec^{-1} for the effective recombination coefficient of the E-layer. The rocket observations also indicate that the ionizing radiation causing the E-layer is reduced during the eclipse in proportion to the intensity of the measured band of X-rays. The variation of electron temperature in the E-region due to the eclipse is found to be small. The electron density in the D-region (50–90 km) shows a more complex variation. Author

N66-17163# Genoa Univ. (Italy). Istituto Geofisico e Geodetico.
REPORT OF ACTIVITIES FOR THE THREE YEARS 1962, 1963 AND 1964 [RELAZIONE SULL'ATTIVITA SVOLTA NEL TRIENNIO 1962–1963–1964]
Mario Bossolasco 30 Jan. 1965 15 p refs In ITALIAN
CFSTI: HC $1.00/MF $0.50

Research is reported in the following areas: (1) aeronomy and geomagnetism; (2) meteorology; (3) marine physics; (4) gravimetry and seismology; and (5) geology and geography. A bibliography of publications is included. Transl. by D.T.

N66-17189* National Aeronautics and Space Administration, Washington, D. C.
THE EFFECT OF A LIGHT COVER ON THE FREQUENCY OF RECORDED EXTENSIVE AIR SHOWERS
D. D. Krasil'nikov, N. N. Yefimov, M. A. Nifontov, and V. A. Orlov *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 12–13 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

The effect of a thin cover on the number of recorded cosmic ray showers was studied by identical neutron counters. Apparata were operated for 24 hours between September 5 and September 12, 1958. Comparison of the recorded values with data obtained from devices operating in open air without any cover did not produce any marked differences. On the contrary, 1 to 1.5% more showers were recorded by the covered apparata, probably due to the transition effects of the cover. G.G.

N66-17191* National Aeronautics and Space Administration, Washington, D. C.
DEPENDENCE OF THE SEPARATION CURVE ON THE MEAN SIZE OF AN EXTENSIVE AIR SHOWER
D. D. Krasil'nikov, N. N. Yefimov, M. A. Nifontov, and F. K. Shamsutdinova *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 20–23 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

The dependence of the frequency of recorded extensive atmospheric showers on the distance between neutron counters placed at the corners of a square was studied. Measurements were made of six-fold coincidences over the area of the counter groups and along the diagonal of the square. Experimental values were compared to calculated frequencies obtained by spatial distribution functions, and showed good agreement. An appreciable dependence of 40 to 100 m separations for the mean size of the recorded showers was established. G.G.

N66-17193* National Aeronautics and Space Administration. Washington, D. C.
AUTOMATIC FRAME-BY-FRAME PHOTOMETRY OF ALL-SKY PHOTOGRAPHS
Yu. A. Nadubovich *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 31–42 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Described is an automatic frame-by-frame photometer for continuing sky photography which allows each frame to be examined as a whole rather than point by point. Mean values for the blackening over the whole frame are developed and then converted to the mean luminous flux by plotting the absolute exposure in flux-seconds as a function of the transmittance. This method showed good agreement with point-by-point photo evaluation. G.G.

N66-17194* National Aeronautics and Space Administration, Washington, D. C.
A NEW METHOD FOR RECORDING EARTH CURRENTS
E. P. Zubareva and Yu. Z. Nadubovich *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 43–46 (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

An automatic electronic self-recording potentiometer for the recording of earth currents was developed and evaluated. This apparatus does not need a dark enclosure and massive foundations to record the components of an electrotelluric field as the current flows along the line connecting the electrodes to the earth current station. It uses the potential difference caused by a resistance between the electrodes for direct inscription onto a recording chart. Recordings showed a greater number of details than tracings obtained by standard apparatus. G.G.

N66-17233*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PARTICLE TRAJECTORIES IN MODEL CURRENT SHEETS. 2: ANALYTICAL AND NUMERICAL APPLICATIONS TO AURORAS USING A GEOMAGNETIC TAIL MODEL
T. W. Speiser Nov. 1965 52 p refs Submitted for Publication (NASA-TM-X-55395; X-641-65-451) CFSTI: HC $3.00/MF $0.50 CSCL 04A

Individual particle trajectories are solved for three models of possible field configurations of the geomagnetic tail. Two models contain magnetic field lines oppositely directed on either side of a neutral sheet, with an electric field perpendicular to the magnetic field and parallel to the neutral sheet. The models differ in the rate of variation of a magnetic field component perpendicular to the neutral sheet. For the two models, particles are accelerated and turned toward the earth within the neutral sheet and are ejected from the neutral sheet with small pitch angles to a magnetic line of force, with energies of tens-of-kilovolts. For the first model, a dipole-plus-tail model, electrons are ejected at about 150 R_e and protons about 50 R_e back in the tail. For the second model, an extended-tail-model, electrons are ejected at about 500 R_e, and protons at about 400 R_e. The third model consists of a three-dimensional dipole field added to a tail/neutral-sheet field. Author

N66-17244*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOMAGNETIC FIELD LINE DATA FOR THE NOVEMBER 12, 1966 TOTAL SOLAR ECLIPSE
Juan G. Roederer Dec. 1965 13 p refs Prepared for NSF (NASA-TM-X-55412; X-640-65-512) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Tables on geomagnetic field line geometry data are presented to facilitate planning of experiments on plasma flow and wave propagation along field lines during the total solar eclipse of November 12, 1966. For the numerical calculations, a modified and implemented version of McIlwain's INVAR code was used which gives all the additional information such as conjugate intersects, equatorial points, total arc lengths, etc., without requiring a second line tracing. An explanation of the tables, and a map showing the path of the total phase and the corresponding conjugate intersects at an altitude of 300 Km are included. R.N.A.

N66-17252*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MODELS OF THE EARTH'S MAGNETIC FIELD
Joseph C. Cain 1 Oct. 1965 35 p refs Presented at the Advanced Study Inst., Bergen, 16 Aug. 1965 (NASA-TM-X-55379; X-612-65-400) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Four mathematical models of the earth's magnetic field were constructed from currently available magnetic survey data obtained from magnetometers placed on land and towed behind ships and aircraft. The data are varied. Four separate magnetic field forces are defined: the core field; the crustal field; ionospheric currents; and plasma pressures. Most of the discussion and the field plots are confined to the core field (the main field from the molten core of the earth). The technique by which the core field is analyzed; and characteristics of the four core field models are discussed. Comparison of the field models indicate that the method of fitting the measured data themselves instead of reading the data directly from magnetic charts is a useful approach and produces fields whose errors in regions of good data coverage are only a fraction of those previously obtained. As more data become available, the models should improve even further. L.S.

N66-17257*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETOPLASMA DIFFUSION AT F2 REGION ALTITUDES
P. C. Kendall Oct. 1965 21 p refs (NASA-TM-X-55384; X-615-65-409) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The magnetoplasma diffusion equation of the F2 region of the ionosphere is derived in its primitive form, allowing for electric currents flowing between conjugate points of the dynamo region, and for temperature variations. It appears that the standard view of the ambipolar diffusion problem is correct. The ion-electron pairs may be thought of as sliding down the magnetic field lines with diffusive motion, while the whole field line drifts at right angles to itself. The electric current along a field line would affect the ionization only if its magnitude were 100 times greater than Dougherty's estimate of 10^{-7} amps/m^2. Author

N66-17263*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NEW LOOK AT THE EARTH'S MAGNETIC FIELD
Norman F. Ness Nov. 1965 73 p refs Presented at the AAAS Meeting "Moving Frontiers in Sci.," Berkeley, Calif., 26 Dec. 1965 (NASA-TM-X-55393; X-612-65-447) CFSTI: HC $3.00/MF $0.75 CSCL 04A

Satellite experiments reveal that the *solar wind* confines the geomagnetic field to form the *magnetosphere* and an extended comet-like *magnetic tail*. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-16199# Yerkes Observatory, Williams Bay, Wis.
RESEARCH, DESIGN, AND FABRICATION OF AN IMAGE TUBE FOLDED SCHMIDT SPECTROGRAPH Final Report, 1 Apr. 1963–30 Sep. 1965
W. A. Hiltner 18 Oct. 1965 14 p
(Contract AF 19(628)-2922)
(AFCRL-65-730; AD-623914) CFSTI: HC $1.00/MF $0.50

A spectrograph has been designed and constructed that will accommodate either the RCA cascaded image tube or an electronographic image tube if the photocathode can be operated near ground potential. The spectrograph is a grating one with an on-axis collimator, pierced grating and Schmidt camera. The complete spectrograph body is cradled in a frame that attaches to the telescope. The dispersions are 50 and 100 Å/mm. Author (TAB)

N66-16216# General Electric Co., Ithaca, N. Y. Advanced Electronics Center.
THE VISILOG: A SYNTHETIC EYE Technical Documentary Report, 1 Jul. 1963–29 Feb. 1964
Paul W. Charton and Erman E. Ferris Wright-Patterson AFB, Ohio, AF Avionics Lab., Jan. 1965 83 p refs
(Contract AF 33(657)-11179)
(AL-TDR-64-185; AD-611539) CFSTI: HC $3.00/MF $0.75

The VISILOG is an automatic obstacle avoidance machine whose principle of operation is based upon the analog of the visual senses. The subject of this investigation was a stationary slant-perceiving VISILOG, where the slant of a surface is measured by use of the texture density gradient as observed in the retinal plane. Texture density gradients may be measured by scanning a retinal plane image to determine the number of texture elements in a given scan and comparing the values for the near field and far field scans. Projected artificial textures which eliminate the emergent texture problem are analyzed as a method for extracting surface slant from the observed retinal plane patterns. Several VISILOG configurations are examined from the equipment point of view and the advantages and disadvantages of each are considered. Experimental verification of the VISILOG method of measuring surface slant is obtained and the effects of stochastic surfaces upon measurement accuracies demonstrated. The results obtained on this program indicate that the stationary slant measurement VISILOG is useful only in limited environmental situations. TAB

N66-16219# Internationale Atomreaktorbau Gesellschaft, Bensberg (West Germany).
DEVELOPMENT OF A CHALK DUST MEASURING DEVICE [ENTWICKLUNG EINES KALKSTAUBMENGEN-MESSGERATES]
K. Schmidt and A. Naseband Brussels, EURATOM, Dec. 1965 59 p In GERMAN; ENGLISH summary
(Contract EURATOM-004-62-9 IRAD)
(EUR-2544.d) CFSTI: HC $3.00/MF $0.50

It was shown that ionizing radiations can be used for fine chalk density determination. Suitable sources are the bremsstrahlung from Sr/Y-90 backscattered from a silver target, the beta-radiation from Sr/Y-90 and the gamma-radiation from Am-241. The first measuring rig is based on a zero compensation involving constant comparison of the measuring radiation intensity with that of a standard radiation. In the second rig detector amplification is stabilized by means of a standard radiation. The measuring radiation intensity recorded indicates the fine chalk density. The use of bremsstrahlung involved a margin of error of as much as 10% at an acceptable radiation source activity and an adequate recording speed. With beta-radiation, the measuring values are reproducible within 1% margin of error. With Am-21 gamma-radiation, the second rig gave a margin of error of 1% with a long-time stability within 1–2%. Author

N66-16221 Hewlett-Packard Co., Palo Alto, Calif. Frequency and Time Div.
FREQUENCY AND TIME STANDARDS
James H. Sheldon and Jane Evans Nov. 1965 104 p refs *Its* Application Note 52, Revised
(AN-52, Rev.)

Principles of precision frequency and time standards, with emphasis on practical working methods of frequency and time determination, are briefly reviewed and the application of atomic beams and crystal oscillators in time comparison methods is evaluated. Cesium and hydrogen beams represent truly primary frequency standards that need no other reference for calibration; quartz oscillators and rubidium vapor are regarded as secondary frequency standards requiring calibration against a primary standard. A variety of time comparison measurement systems are described that utilize combinations of primary and secondary standards to determine exact frequency intervals. Appendices contain descriptions of a number of standardization devices. G.G.

N66-16231# Harry Diamond Labs., Washington, D. C.
EXPERIMENTAL MECHANICAL TIMER WITH DETACHED LEVER ESCAPEMENT AND DIGITAL READOUT SYSTEM
David L. Overman and David S. Bettwy 31 Aug. 1965 43 p
(HDL-TM-65-44; AD-624746) CFSTI: HC $2.00/MF $0.50

Results of design investigations and performance tests are presented for an experimental mechanical interval timer. This unit was designed to provide one output, with an accuracy of ±0.2 sec, selected from six possible timing intervals between 40 and 120 sec by a one-knob control. It is an all-mechanical system with a volume of approximately 6 cu in. The models performed within specifications, and test results indicate that the desired accuracy can be achieved in a production timer of this type. Author (TAB)

N66-16235*# Yerkes Observatory, Williams Bay, Wis.
STUDY AND EVALUATION OF ELECTRONOGRAPHY Final Report
W. A. Hiltner 30 Jul. 1964 23 p refs
(Grant NsG-546)
(NASA-CR-69830) CFSTI: HC $1.00/MF $0.50 CSCL 14E

An attempt was made to acquire information concerning the absolute efficiencies of photographic and electronographic emulsion processes, under a restricted set of relevant parameters. Equations were developed for calculating macroscopic detective quantum efficiency as a function of density, i.e., exposure in photons or photoelectrons per unit area, where the total exposure area is understood to be large compared with

the area of a resolution element. Thus, this determination of efficiency is appropriate only to the detection of a low contrast image which is completely resolved. Photographic density measurements were made on both unbeked and baked plates. The maximum efficiencies, calculated directly as a function of exposure, reach maxima of 5×10^{-3} and 6×10^{-2}, respectively, at a density about 0.25 above fog. Electronographic efficiency, also calculated as a function of exposure, reaches a maximum of 1.4×10^{-2} at a density about 0.2 above fog. D.T.

N66-16236# Aerodynamische Versuchsanstalt, Gottingen (West Germany).

FLOW MEASUREMENT AND AUXILIARY ARRANGEMENTS [STROMUNGSMESSGERATE UND HILFSEINRICHTUNGEN]

1964 86 p refs In GERMAN

CFSTI: HC $3.00/MF $0.75

A variety of flow measuring devices applicable to liquid and gaseous media are described and discussed. All gauges either utilize pressure differentials or temperature variations to obtain flow measurements. Emphasis is placed on aerodynamic flow sensors, micromanometers, pressure scales, and thermal flow velocity sensors. Transl. by G.G.

N66-16243# Japan Broadcasting Corp., Tokyo. Technical Research Labs.

A STUDY OF FILM CAMERA THREE-COLOR SEPARATION SYSTEM

Haruo Sakata Sep. 1965 34 p refs *Its* Labs. Note No. S-3

CFSTI: HC $2.00/MF $0.50

In this study the essential emphasis has been placed on the fact that the light incident on the film camera is controlled spectrally by the color film dyes. For fidelity transmission of the colors of an object, the film is considered simply as a medium of color transmission and a method of matching the spectral characteristic of the film camera to the film dyes is proposed. The spectral characteristic of the film camera of the conventional system and the system proposed in this study were measured with reference to the reproduced colors of standard color dyes as objects. In addition, extensive evaluation tests were made on the colors of color films and slides reproduced on the picture tube in these two systems, and as a result it was confirmed that improvements could be made on the reproduced colors by the employment of this proposed method. Author

N66-16307# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONSTRUCTION AND APPLICATION OF AN AUTOMATIC NOISE SPECTROMETER

H. J. Gasse 15 Sep. 1965 18 p refs Transl. into ENGLISH from Hochfrequenztech. U. Elektroakust (Leipzig), v. 73, no. 2, 1964 p 54–58

(FTD-TT-65-752/1+2+4; AD-471388)

This is a description of an instrument which enables one to carry out the Fourier analysis of an electrical signal in the frequency range of 15 c/s to 60 kc/s. The instrument operates with a constant absolute band width (20 c/s) and is primarily intended for noise measurements. A twin-heterodyne amplifier is automatically (exponentially with time) tuned, and a compensation recording instrument registers the logarithm of the effective value of the respective frequency. Author (TAB)

N66-16386*# Sanders Associates, Inc., Nashua, N. H. Instrument Div.

DESIGN OF A RECTILINEAR ACCELEROMETER Final Report

10 Nov. 1965 97 p

(Contract NAS8-20519)

(NASA-CR-69852) CFSTI: HC $3.00/MF $0.75 CSCL 14B

Design details and performance evaluation of a prototype rectilinear accelerometer are discussed. This spring mass accelerometer will be used to measure the lateral acceleration on the Saturn launch vehicle during passage through jet streams, and to direct the engines into the proper angle of attack. Test data showed that the self-test forcer was about three times stronger than required; it was concluded that a single permanent magnet mounted close to the flux path across the moving coil would be sufficient to develop the necessary force. Preliminary tests on the "S" spring diameter indicated a reduction to 2" in as feasible. The prototype design of the linear variable differential transformer met the expected travel of ±.125. G.G.

N66-16400# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

TEST AND EXPERIMENTATION ON CONSOLE MAP PROJECTION SYSTEM Final Report

George A. Scott Oct. 1965 41 p

(RD-65-108)

This report contains the operational and technical criteria that are necessary for the development of production specifications for a thirty-five mm rear view slide projection system. The recommended criteria were derived from experimentation with various types of projection systems. Production models of the system may be used by Air Route Traffic Control Center controllers to select and display the necessary aeronautical information on a screen located in the existing M-1 console mapboard area. Author

N66-16430# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).

DIGITAL METHODS IN THICKNESS GAUGING. A: THICKNESS GAUGE FOR FAST MOVING DISCONTINUOUS MATERIALS. B: CONTROL DEVICE FOR TUBE WALL THICKNESS

K. E. Duftschmid, J. Steidl, R. Patzelt, W. Attwenger, D. Donhoffer et al [1965] 29 p refs Presented at the Symp. on Radioisotope Instr. in Ind. and Geophys., Warsaw, 18–22 Oct. 1965

(SGAE-IB/1A-6/1965) CFSTI: HC $2.00/MF $0.50

A thickness gauge for fast moving discontinuous sheets of material in a thickness range of 600 to 1500 mg/cm^2 which uses Ru/Rh-106 as a beta radiation source and a digital measuring system is described. Also, the measurement of wall thickness and concentricity of tubing with Ru/Rh-106 or Sr/Y-90 beta source and a digital system is discussed. Theory of beta radiation measurements, electronic instrumentation, and performance of these techniques for determining wall thicknesses are included. The accuracy of the sheet thickness gauge is estimated to be 0.6% and for the tubing thickness gauge 0.06 mm or 1% of maximal thickness if Sr-90 is used. The accuracy is slightly less with Ru-106 beta sources. E.E.B.

N66-16490# Autonetics, Downey, Calif.

DIGITAL MAGNETIC RECORDING Selected Bibliography, 1959–Jun. 1965

C. F. G. Lyau and Vivian J. Mungle 31 Aug. 1965 49 p refs

(T5-1585/3111; AD-469876)

This selected bibliography is prepared to provide readily available information on digital magnetic recording techniques and materials in support of the MEM-BRAIN Disk File Internal Research and Development Program. This program consists of the development of a two gigabit mass storage device. The main topics covered in the literature search are: Magnetic Recording Techniques, Magnetic Recording Materials, Magnetic Recording Heads, and Disk-Drum File Applications. This bibliography contains 129 references which include reports, papers and periodical articles covering the period from 1959 through June 1965. Author (TAB)

N66-16492# Industrial Science and Technology Agency, Tokyo (Japan). Electrotechnical Lab.
RESEARCHES ON PRECISION AC AND DC WATT-TO-PULSE FREQUENCY CONVERSION FOR STANDARDS
Shoji Kusui Dec. 1964 124 p refs In JAPANESE; ENGLISH summary *Its* Res. of the Electrotech. Lab. No. 654
CFSTI: HC $4.00/MF $1.00

The development of a device for converting ac or dc watts to pulse frequency, and for direct comparison of the ac/dc watt-hour by use of counters, is described. The conditions for using the converter as a standard are listed as (1) reading accuracy of better than 0.01%; (2) stability better than 0.01% for a test time; (3) ac/dc transfer error of less than 0.02%; (4) voltage and current characteristics (linearity) of better than 0.01% per 10% variations from test points; and (5) reading rapidly carried out. A basic block diagram of the ac/dc watt-pulse frequency converter is shown, and the characteristics of the self-balanced 3-phase ac/dc watt comparator are tabulated. M.G.J.

N66-16573*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FORCE MEASUREMENT IN A VACUUM ENVIRONMENT BELOW 10^{-6} TORR
Dean C. Glenn Washington, NASA, Feb. 1966 10 p refs
(NASA-TM-X-1209) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A capacitance force transducer is described which was developed to measure the torque of a rolling-element bearing with both transducer and bearing in a vacuum environment (10^{-7} torr (1.33×10^{-5} N/m^2). The transducer is capable of measuring forces from 2.2×10^{-3} to 1.32 pounds (9.807×10^{-3} to 5.884 N) and can be calibrated statically for vacuum operation at atmospheric pressure. Author

N66-16649# Utah State Univ., Logan. Electro-Dyanmics Labs.
DUAL-CHANNEL SATELLITE RADIOMETER Final Report
Craig A. Mortensen, Doran J. Baker, and Clair L. Wyatt 1 Aug. 1965 67 p refs
(Contract AF 19(628)-4209)
(AFCRL-65-491; AD-625380) CFSTI: HC $3.00/MF $0.75

A two-channel infrared radiometer designed for use in satellites and space probes is described. The radiometer uses an optical chopper and correlated amplifier system. It uses lead sulfide, lead selenide, or silicon photovoltaic detectors. The minimum detectable radiance is 4×10^{-7} watt/sq cm/steradian at wavelengths of 2.2 and 2.7 microns. The radiometer has a five decade dynamic range. Author (TAB)

N66-16682# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
A PROBE FOR THE MEASUREMENT OF HIGH SURFACE TEMPERATURES Technical Report, 5 Mar. 1964–1 Jul. 1965
Gerald A. Sterbutzel Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1965 62 p ref
(Contract AF 33(615)-1485)
(AFFDL-TR-65-121; AD-624888) CFSTI: HC $3.00/MF $0.75

The report describes the design, operation and performance of a probe system with which temperatures can be measured quickly and accurately on a variety of surfaces. In operation the probe is touched to the surface and through its own sensor, heater and electronic servo system is automatically adjusted to the undistorted surface temperature. Extensive testing on a variety of materials (including alumina, stainless steel, titanium, Rene 41, disil coated molybdenum, disil coated columbium, zirconium, and quartz) has shown it generally to have an accuracy of better than 1/2%. The highest temperature measured successfully in intermittent steady state tests was about 2450°F (1343°C) and in transient tests was 2994°F (1645°C). Author (TAB)

N66-16748*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A PRESSURE TELEMETER FOR WIND-TUNNEL FREE-FLIGHT PRESSURE MEASUREMENT
Royal G. Harrison, Jr. 1 Feb. 1966 18 p refs
(Contract NAS7-100)
(NASA-CR-70038; JPL-TR-32-763) CFSTI: HC $1.00/MF $0.50 CSCL 14B

This report summarizes the work on a pressure telemeter—the instrument, itself, and the applicable telemetry technique—developed for use in studying interference-free pressures on models launched into free flight in a hypersonic, continuous-flow wind tunnel. Design characteristics, performance, and operational procedures, as well as problems that were delineated during the development phase, are described. The pressure measurements obtained during the experiments were of base pressures on 10- and 15-deg half-angle cones. There was good correlation between theoretical predictions and experimental data, and findings confirm that the pressure telemeter is operational and produces valid data. Author

N66-16759# European Atomic Energy Community, Brussels (Belgium).
CONSTRUCTION AND CALIBRATION OF A PROTON RECOIL TYPE NEUTRON SPECTROMETER
F. Cappellani, P. F. Cecchi, and A. Fubini (Comitato Nazionale Per l'Energia Nuclear, Bologna (Italy) Nov. 1965 18 p refs
(EUR-2491-e) CFSTI: HC $1.00/MF $0.50

A fast neutron spectrometer based on the collimated proton recoil method, using a methane filled proportional counter assembly, is described. The response function and the efficiency of the spectrometer, measured with neutron energies from 0.2 to 2 MeV, are reported. Author

N66-16766# Joint Publications Research Service, Washington, D. C.
[IZVESTIYA VUZov: INSTRUMENT BUILDING, VOLUME, VIII, NO. 5, 1965
S. I. Zilitinkevich, ed. 24 Jan. 1966 231 p refs Transl. into ENGLISH of Izv. Vysshikh Uchebn. Zavedenii, Priborostr. (Leningrad), v. 8, no. 5, 1965 p 1–164
(JPRS-33860; TT-66-30303) CFSTI: $4.00

Electronic, electrical, optical, mechanical, and thermal instrument construction is discussed for various applications. For individual titles see N66-16767–N66-16798.

N66-16772 Joint Publications Research Service, Washington, D. C.
SEMICONDUCTOR METER FOR STATIC ELECTRICITY CHARGE
V. N. Shikhov, V. P. Sitnikov, and O. A. Petrov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 29–32 refs (See N66-16766 07-14) CFSTI: $6.00

This article presents a description of a semiconductor instrument for the measurement of the potential and surface density of electrostatic charges on equipment and machined dielectrics under production conditions. Author

N66-16773 Joint Publications Research Service, Washington, D. C.
AUTOMATIC MEASUREMENT AND REGULATION OF PULP DENSITY BY A MICROWAVE METHOD
S. I. Golota *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 33–40 refs (See N66-16766 07-14) CFSTI: $6.00

A new microwave method for the determination of pulp density (in titanium–magnesium production) is described. A completely transistorized device (with the exception of the oscillator tube) was developed for the monitoring and regulation of the pulp density. The microwave densitometer gave satisfactory results in tests in a production plant. Author

N66-16775 Joint Publications Research Service, Washington, D. C.
INSTRUMENT FOR MEASURING CONTROL, CONDUCTION AND COMMUTATION ANGLES OF CONVERTER RECTIFIERS
O. A. Mayevskiy and O. P. Kotlyarov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 46–54 refs (See N66-16766 07-14) CFSTI: $6.00

An instrument is described which measures control, conductance, and commutation angles in rectifier converters with different types of rectifiers, different connection schemes, and different control methods. The absence of galvanic connection of the sensors with the power and control circuits of the converter eliminates the effect of the measuring instrument on the converter operation and enables measurements to be made in operating equipment without disturbing the circuit by simply introducing the sensors into the anode circuit of the rectifier. The measuring device can be used in converters with high plate voltage. The instrument errors are less than 1.5% which is adequate for measuring industrial equipment. R.N.A.

N66-16786 Joint Publications Research Service, Washington, D. C.
IMPERTURBABILITY OF THE GYROSCOPIC PENDULUM
M. Z. Litvin-Sedoy *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 117–119 refs (See N66-16766 07-14) CFSTI: $6.00

This paper presents the conditions for imperturbability of the direction toward an attracting center of the axis of a gyroscopic pendulum of variable length with movement of the pendulum support point. Author

N66-16788 Joint Publications Research Service, Washington, D. C.
EFFECT OF ELASTIC PROPERTIES OF SUPPORT ELEMENTS OF GYROTACHOMETER ON FREQUENCY OF ITS FREE OSCILLATIONS
E. I. Sliv and M. A. Uzkaya *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 124–130 refs (See N66-16766 07-14) CFSTI: $6.00

This article considers the question on the effect of the elastic properties of the support elements of a gyrotachometer on the frequency of its free oscillations. It is shown that the deformation of the supporting elements has a significant effect on the frequency of the free oscillations of the gyrotachometer. Author

N66-16789 Joint Publications Research Service, Washington, D. C.
INCREASING THE SENSITIVITY OF THE STRING ACCELEROMETER
Yu. D. Tsodikov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 131–139 refs (See N66-16766 07-14) CFSTI: $6.00

This paper analyzes the causes of the occurrence of insensitivity in the string accelerometer and considers the basic method for its reduction. On the basis of the analysis of two coupled string auto-oscillators it is shown that the zone of insensitivity can be reduced considerably with excitation of the strings at different harmonics. Author

N66-16790 Joint Publications Research Service, Washington, D. C.
SIMPLIFIED METHOD OF DETERMINATION OF ERROR FUNCTION OF DISPLACEMENT OF GEAR MECHANISMS WITH DIFFERENCE METHODS OF CONTROL
N. G. Lindtrop *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 140–145 refs (See N66-16766 07-14) CFSTI: $6.00

This paper presents a simple method for the determination of the primitive periodic function using difference measurements with a constant gaging base without the use of laborious harmonic analysis. Author

N66-16792 Joint Publications Research Service, Washington, D. C.
INTERNAL STRESSES ARISING WITH BALSAM COATING OF OPTICAL PLANE-PLATES
G. F. Pishchik, Ye. N. Prokof'yev, O. Ye. Ol'khovik, and L. V. Sergeyev *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 153–159 refs Presented at the All-Union Conf. on Opt. Polarization Method of Anal. of Stresses, Leningrad, Jun. 1964 (See N66-16766 07-14) CFSTI: $6.00

This paper describes an experimental and theoretical investigation of the internal stresses caused by the bonding material in optical plane-parallel plates. An analytic analysis using the mathematical theory of an elastically deformed medium is presented. Author

N66-16793 Joint Publications Research Service, Washington, D. C.
METAL CALORIMETER FOR THERMOPHYSICAL INVESTIGATIONS
V. V. Kurepin and Ye. S. Platunov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 160–166 refs (See N66-16766 07-14) CFSTI: $6.00

This article presents the description of the design and principle of operation of a calorimeter for thermophysical measurements over a wide range of temperatures. A method for the calibration of the calorimeter is proposed. Author

N66-16794 Joint Publications Research Service, Washington, D. C.

HIGH-FREQUENCY RESISTANCE THERMOMETER

V. G. Volkov, I. P. Pelepeychenko, and D. F. Simbirskiy *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 167–171 refs (See N66-16766 07-14) CFSTI: $6.00

This paper presents the principle of operation, the circuit and data from the experimental verification of a high-speed high-frequency resonant resistance thermometer. A considerable increase of its sensitivity in comparison with the conventional thermometer is established. Author

N66-16795 Joint Publications Research Service, Washington, D. C.

DESIGN OF THERMAL AND VISCOUS VACUUM GAGES AND HOT WIRE ANEMOMETERS

R. S. Prasolov and A. D. Terekhov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 172–178 refs (See N66-16766 07-14) CFSTI: $6.00

An approximate triple analogy is established among the accommodation coefficient a, the momentum transfer coefficient f, and the degree of blackness E on the basis of which it is possible to make a theoretical estimate of the characteristics of various instruments operating in vacuum conditions. Author

N66-16796 Joint Publications Research Service, Washington, D. C.

PRECISION PHOTORESISTOR THERMOREGULATOR

B. A. Tazenkov and I. I. Chaykin *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 180–183 refs (See N66-16766 07-14) CFSTI: $6.00

This paper presents the description of a version of a thermoregulator developed by the authors for the precise measurements of the dependencies of the semiconductor (and any other) specimens. The instrument may find wide application in laboratory practice. Author

N66-16797 Joint Publications Research Service, Washington, D. C.

ANALYSIS OF A SYMMETRICAL DUOFLEX PIVOT

V. N. Zheludkov *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 184–194 refs (See N66-16766 07-14) CFSTI: $6.00

An approximate solution is presented for the symmetric duoflex pivot under the action of an arbitrary two-dimensional system of external forces and moments. Equations are obtained for the angle of rotation of the movable element, the displacement of the geometric axis of the pivot and the stress in the flexible elements. An example of the design of a pivot is given. Author

N66-16862 Midwestern Universities Research Association, Stoughton, Wis.

HIGH SPEED DIGITAL DYNAMIC FIELD MEASURING SYSTEM

George E. Bush *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 407–414 refs (See N66-16826 07-23) CFSTI: $8.50

The design study for a high speed dynamic field measuring system is reviewed with particular attention given to accuracy and data handling. The criteria placed on system speed is presented and the accuracy–speed relationship analyzed. Author

N66-16865 Academia R. P. R., Bucharest (Romania). Inst. of Atomic Physics.

MNR MAGNETOMETRIC DEVICES WITH FLOWING LIQUIDS

Gr. Indreas and N. Scintei *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 428–430 refs (See N66-16826 07-23) CFSTI: $8.50

Flowing liquid samples are proposed, for the choice of optimal conditions of the signal-to-noise ratio, from the point of view of relaxation constants values, in magnetometers with nuclear resonance. A device of this type permits easy measurements of small and inhomogeneous magnetic fields. Author

N66-16867 Brobeck (William M.) and Associates, Berkeley, Calif.

PRECISION MAGNETIC FIELD MEASUREMENTS WITH HALL-EFFECT PROBES

James R. Mulady *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 447–455 refs (See N66-16826 07-23) CFSTI: $8.50

High-precision, magnetic field measurement probes utilizing Hall-effect plates have been developed for use in the mapping of cyclotron and beam transport magnets. These probes employ both bifilar-wound heating elements and a thermistor-resistor network to compensate for the effects of changing ambient temperature and self-heating resulting from variations in power dissipation in the control side of the Hall plate. These probes have been used to map the main field and the beam transport magnets of a 600 MeV synchrocyclotron, and will be used for similar measurements on a 70-inch AVF cyclotron. Results obtained with these probes, including calibration techniques, resolution, and sensitivity drift, are described. Author

N66-16869 University of Southern Calif., Los Angeles.

WIRE ORBIT MEASUREMENTS WITH A PULLEY OF LOW FRICTION

Hans Bichsel *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 467–471 refs (See N66-16826 07-23) CFSTI: $8.50

Details are given on the development and testing of an air pulley for frictionless operation. In the device, two air supply holes of 1.02 mm dia were used for each side; a drawing of the cross section is included. Mechanical means were used to determine its performance characteristics, and experiments were conducted with the pulley used as an unloaded and loaded physical pendulum. Indications are that for static applications, no perceptible friction occurs in the air pulley. However, several extraneous torques will tend to produce errors and will have to be studied for each individual pulley. It was pointed out that since the applied torques for wire orbit measurements are usually of the order of 700000 dyne cm, the total error introduced by the pulley did not amount to more than $4 \cdot 10^{-4}$; careful measurements should reduce this to 1 in 10^4. M.G.J.

N66-16870 Institute of Physical and Chemical Research, Tokyo (Japan). Cyclotron Lab.

A SIMPLE AND CONVENIENT METHOD FOR FIELD MAPPING BY DIFFERENTIAL USAGE OF HALL GENERATORS

Masataka Henmi, Takashi Karasawa, and Shyoshichi Motonaga *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 472–475 refs (See N66-16826 07-23) CFSTI: $8.50

Two Hall generators, one fixed and the other moving, are used to measure magnetic field distribution. Each generator is excited separately with a stabilized current supply, and both exciting currents are adjusted to the same sensitivity. Difference between the two Hall voltages is automatically recorded on an X-Y recorder, which immediately obtains the relative distribution. The effective temperature coefficient is reduced and precise thermal control is lacking. A relative distribution of less than four parts in 10^5 can be measured, with a position resolution of about one millimeter. M.W.R.

N66-16872 Kernforschungsanlage, Juelich (West Germany).
THE BEHAVIOUR OF HALL-PROBES IN MAGNETIC GRADIENT FIELDS
Branko Berkes *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 483–486 refs (See N66-16826 07-23) CFSTI: $8.50

Thermomagnetic and galvanomagnetic effects limit the accuracy of Hall probes in homogeneous magnetic fields; and the most serious problem is the dependence of Hall voltages and internal resistances upon temperatures. In magnetic fields with strong gradients, accuracy to within 0.01% cannot be achieved because of errors in the gradient itself. Current-side internal resistances are different if the Hall probe is mounted with its length perpendicular or in the direction of the gradient. In both instances errors in the Hall voltages result which are proportional to the gradient of the field. For one Hall probe, errors of .02 and .04% are found for a field of 12 kgauss and a gradient of 6 kgauss cm. M.W.R.

N66-16874 Argonne National Lab., Ill.
A PRECISION SYSTEM FOR MEASURING WIRE TRAJECTORIES IN MAGNETIC FIELDS
L. G. Ratner and Robert J. Lari *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 497–504 refs (See N66-16826 07-23) CFSTI: $8.50

The design and operational characteristics of a system for measuring particle trajectories by means of a floating wire analog are described. Precision in wire current is obtained by using a ±0.01% power supply and a precision potentiometer and standard cell set-up of ±0.004% accuracy. Precision of tension is maintained by use of an oscillating double-race pulley bearing. A flexible aluminum wire is used to reduce second order effects due to stiffness and gravity. Values of momentum from 100 MeV/c to 15 BeV/c can be easily simulated with loads of 100 gm to 250 gm and 0.05 to 4.0 amperes. For position readout of the wire orbit in space, a set of coordinate frames using 40 X microscopes and precision lead screws gives better than 0.001-in. accuracy. With this equipment, one is able to simulate both extended and point sources of beams. Measurements of magnetic axes, focal lengths, chromatic and spherical aberrations, and effective lengths as well as particle trajectories are described. Author

N66-16919*# Parametrics, Inc., Waltham, Mass.
ULTRASONIC TEMPERATURE MEASURING DEVICE Second Quarterly Progress Report
E. H. Carnevale, L. C. Lynnworth, and S. L. Klaidman Jan. 1966 14 p refs
(Contract NAS3-7981)
(NASA-CR-54896) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Work proceeded on room and elevated temperature ultrasonic measurements and analysis, on radiation capsule design, on analyzing and estimating radiation effects in refractory sensor wires, on planning for the radiation experiments in the test reactor, and on measurements essential to the design and construction of the ultrasonic pulsing unit. Molybdenum wire was ultrasonically tested up to 4500°R in a carbon atmosphere. To permit operation of Mo and other refractory wires up to 5000°R for extended periods of time, it will be necessary to minimize or prevent carbon reactions with the sensor wire. Several approaches to this problem have been considered. To obtain the required temperature accuracy, ±50°R, and spatial resolution, 1 to 3 inches, ultrasonic frequencies of the order of 1 megahertz have been considered. Such frequencies can be generated magnetostrictively or piezoelectrically, and the vibration modes may be extensional or shear. It appears that sensor performance can be improved by operating at these relatively high ultrasonic frequencies. Author

N66-16936*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SOFT X-RAY PHOTOIONIZATION DETECTOR
R. M. Young and A. K. Stober Washington, NASA, Feb. 1966 13 p refs
(NASA-TN-D-3169) CFSTI: HC $1.00/MF $0.50 CSCL 14B

In this paper, a direct-current, gas-filled ionization chamber, which is a simple ceramic radiation detector used in solar and astrophysical observations from rockets and satellites, is discussed. The detector consists of a ceramic shell incorporating a beryllium window and containing xenon fill gas. The sensitivity is determined by the ion-pair yield and spectral absorption characteristics of xenon along with the transmission properties of beryllium. The fabrication technique for this detector and some observed operating characteristics are also described. Author

N66-17026# Perkin-Elmer Corp., Norwalk, Conn.
RESEARCH IN AUTOMATIC BALLOON INSTRUMENTATION FOR SELENODETIC MAPPING PHOTOGRAPHY Final Report
20 Feb. 1964 124 p refs
(Contract AF 19(628)-2396)
(AFCRL-64-201; AD-430942) CFSTI: $9.60

A study was conducted to determine the feasibility of an automatic balloon-borne selenodetic plate camera for high resolution photography of the moon. The areas of investigation include the optical system, system configuration, system stabilization, photographic materials, plate camera arrangement and operation, plate calibration, possibilities for improved resolution, and estimated system performance. Diagrammatic arrangements of the system are provided. Studies indicate that low-contrast lunar details having dimensions exceeding 1000 feet can be recorded photographically by working at the f/20 focal plane of a 36-inch telescopic optical system. The optical form will be similar to that employed in Statoscope II. Study results indicate the desirability of incorporating ground-controlled acquisition and automatic tracking of the lunar surface. It is concluded that an automatic tracking borne selenodetic plate camera system is feasible. In preliminary exploration of the moon, selenodetic photography is useful for identifying areas suitable for detailed investigation prior to unmanned and manned landings. The system, if flown outside most of the earth's atmosphere, would be capable of routinely producing lunar photographs with resolutions which have not been obtained from terrestrial observing sites.
Author (TAB)

N66-17097*# Consolidated Systems Corp., Pomona, Calif.
P-107A HYDROGEN LEAK METER Final Report

Jun. 1965 13 p
(Contract NAS8-5243)
(NASA-CR-70325) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A program was conducted leading to the design, fabrication, test, and delivery of several meters for the measurement of hydrogen leakage in liquid propulsion systems. Emphasis is placed on a technical discussion of the low flow improvement, mass flow calculations, temperature control, matching cell factors, and output adjustment availability. A tabulation of acceptance test results is included. C.T.C.

N66-17100*# Cryonetics Corp., Burlington, Mass.
DIFFERENTIAL TEMPERATURE CRYOGENIC LIQUID LEVEL SENSING SYSTEM Final Report
J. A. O'Neil and E. D. Mills 15 Apr. 1965 66 p refs
(Contract NAS8-11734)
(NASA-CR-70317) CFSTI: HC $3.00/MF $0.75 CSCL 14B

Design and development is documented for a differential temperature cryogenic liquid level sensing system. The principle of operation is discussed, and includes thermodynamic analyses and characteristic curves. Relative to the sensor design, consideration is given to heat transfer in the service media, sensor time response, vibration, shock, service media, proof pressure, and sensor fabrication. In the electronics section, the following areas are discussed: the level set at 6.8 VDC stage, the bridge, the differential amplifier, the double-to-single ended stage, the emitter follower driver, the switching stage, and simulated operation. C.T.C.

N66-17118# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
EVALUATION AND TEST OF A FIVE-COLOR ELECTROSTATIC PRINTING MACHINE FOR THE REPRODUCTION OF TOPOGRAPHIC MAPS AND CHARTS
James W. Gladden Oct. 1965 100 p
(TR-25-TR; AD-624839) CFSTI: HC $3.00/MF $0.75

The report covers the test and evaluation of an engineer-design, test-model, five-color, electrostatic printing machine for the reproduction of 22 1/2- by 30-inch topographic maps from 70-mm microfilm originals. The reproductions are on photoconductive paper utilizing liquid-immersion development. The report also treats the suitability of the machine design as a basis for the combined engineer test–service test models. This report evaluates the registration, image resolution, dimensional stability, continuous-tone possibilities, image quality, maximum-image size, speed, sheeting, and other capabilities of the machine and system for use in printing topographic maps. The report concludes that: the five-color, electrostatic printing machine utilizing 70-mm film chips and liquid immersion development has demonstrated a capability for reproducing acceptable, multicolor topographic maps for field use; the basic machine configuration of the five-color, electrostatic printing machine is sound; various machine processing components need to be modified in order to increase the quality and accuracy of map reproduction. Author

N66-17174# Battelle-Northwest, Richland, Wash. Chemistry Dept.
AN INCREMENTAL DATA RECORDING SYSTEM FOR LOW LEVEL SPECTROMETRY
F. P. Brauer, R. E. Connally, J. H. Kaye, and J. E. Schlosser 1 Mar. 1965 22 p refs
(Contract AT(45-1)-1830)
(BNWL-SA-121; CONF-650401-8) CFSTI: HC $1.00/MF $0.50

An incremental data recording system was applied to low-level single and multiparameter gamma and X-ray spectrometry. The system hardware includes three ADC's (analog to digital converters) with coincidence logic circuits. The digitized pulse height of an accepted event from each ADC is punched on paper tape. Time and identification information are automatically punched on paper tape at the beginning of each pre-set live time period. The punched paper tape is converted to computer-compatible magnetic tape. Various detector assemblies can be used with the converters and recording system. The system software includes a paper tape to magnetic tape conversion routine, an analysis and file maintenance program, a printed display program, a channel summing program, and a weighted least-squares routine used for quantitative analysis of the spectra. All programs are written for use with an IBM-7090 computer. The system was used for various low-level radiochemical analyses involving X-ray-gamma, gamma-gamma, and beta-gamma coincidence techniques. Author (NSA)

N66-17239*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DIGITIZED SPARK CHAMBER FOR GAMMA RAY ASTRONOMY
Charles H. Ehrmann 20 Oct. 1965 23 p refs
(NASA-TM-X-55406; X-611-65-489) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A digitized spark chamber has been developed for balloon borne and satellite gamma ray astronomy. The detector is a multi-array wire, plate chamber utilizing magnetic cores for buffer storage and magnetic tape for data logging. The high voltage system consists of a set of gas krytrons triggered by avalanche transistor pulsers. Track information is stored in parallel into a ferrite core array mounted to the chamber face and buffered via a linear select memory system into a sixteen track sub miniature tape recorder for bulk storage. Also included is a 16 channel rate meter and housekeeping multiplexer which interleaves data with track information onto the tape recorder. The package is designed to operate for long periods of time on a single charge of neon–helium gas in a free balloon environment. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N66-16369*# Boeing Co., Seattle, Wash. Materials and Processes.
RESEARCH STUDY FOR DEVELOPMENT OF TECHNIQUES FOR JOINING OF DISSIMILAR METALS
C. H. Crane, D. T. Lovell, and W. A. Baginski [1964] 117 p refs
(Contract NAS8-11307)
(NASA-CR-69242) CFSTI: HC $4.00/MF $0.75 CSCL 13H

A research program was conducted to: (1) Study and investigate potential methods for joining 2219 aluminum alloy to 321 stainless steel. (2) Demonstrate, on a laboratory scale, the feasibility of adapting the most promising method to production requirements. State-of-the-art cognizance was

established by a comprehensive literature survey and analysis of present technology. Successful diffusion bonding was accomplished at (1) temperatures of 500°F to 600°F, (2) pressures of 20 to 25 ksi and (3) times of 2 to 4 hours. The joint faying surfaces were electroplated with silver prior to bonding to prevent the formation of oxide-film barriers and embrittling phases. Techniques for diffusion bonding of large diameter assemblies were successfully developed and demonstrated by fabrication and testing of four 20-inch diameter joints. Hoop stresses developed during burst testing exceeded the yield strength of the 2219-T62 aluminum alloy. A unique diffusion bonding method was developed utilizing simple differential thermal expansion tooling. The program established that diffusion bonding is the most satisfactory method for joining large diameter stainless steel to aluminum alloy cylinders and is superior in strength and reliability to welding or brazing. Author

N66-16444# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
REVIEW OF LITERATURE IN GENERAL MANUFACTURING [LITERATUUROVERZICHT ALGEMENE WERKTUIBOUW]
25 Sep. 1965 31 p In DUTCH, GERMAN, and ENGLISH *Its* Vol. 3, No. AW-26
CFSTI: HC $2.00/MF $0.50

Abstracts are presented on diesel engines, steam plants, gas dynamics, diffusion welding, ultrasonics, lubricants, metallurgy, supercooling of hydrazine, thermodynamics, and structural dynamics. Also, an article on a simple semi-automatic welding process used extensively in Japan is included. E.E.B.

N66-16450# Joint Publications Research Service, Washington, D. C.
VIBRATION ISOLATION OF MARINE MACHINERY
N. V. Kapustin 29 Dec. 1965 14 p Transl. into ENGLISH from Morskoy Sbornik (Moscow), no. 11, 1965 p 71–77
(JPRS-33532; TT-65-34106) CFSTI: $1.00

Vibration isolation, anti-shock protection, and sound isolation devices for machinery used aboard ships is discussed. Types of supports, mounts, connectors, and inserts used for such isolation techniques are described. The effectiveness of isolation procedures, as evaluated by means of the vibration damping factor; and of the foundation, as evaluated by mass and rigidity are discussed. Designs for isolation supports, and mounts; and for flexible inserts are depicted. L.S.

N66-16567*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
QUALITY REQUIREMENTS FOR HAND SOLDERING OF ELECTRICAL CONNECTIONS
Washington, NASA, Aug. 1964 69 p refs
(NASA-NPC-200-4) GPO: HC $0.45; CFSTI: MF $0.75 CSCL 13H

Quality requirements are established to provide common guidelines and procedures for obtaining effective control of hand soldering for NASA's research and development programs. Environmental conditions, cleanliness, tools and equipment, and methods and techniques are among the topics considered in such areas as facilities, materials, preparation for soldering, soldering of printed circuits, personnel certification, and performance evaluations. C.T.C.

N66-16648# Army Electronics Labs., Fort Monmouth, N. J.
PRESSURE BURSTS IN BAKEABLE ULTRA-HIGH VACUUM VALVES DURING OPENING AND CLOSING
Rudolf G. Buser and John J. Sullivan Sep. 1965 22 p refs
(ECOM-2638; AD-625120) CFSTI: HC $1.00/MF $0.50

The pressure increase Δp produced by opening and closing bakeable ultrahigh vacuum valves of different commercial sources has been determined using mass spectrometric and other standard techniques. Typical results show: (1) Dependence of Δp on geometry and material of bellow seat and gasket and their previous treatment. (2) Δp (bellows; gasket closing, opening) approaches after initial operation a constant value. (3) Δp (closing) $< \Delta p$ (opening for the gasket). (4) Δp (closing) same order of magnitude as Δp (opening for the bellows). (5) Pressure bursts correspond in most cases to an equivalent increase of the partial pressure of H_2. (6) Δp (bellows) shows weak dependence on background pressure, Δp (gasket) is pressure independent. Results are applied to a mass spectrometric sampling method. It is shown that the introduction of bakeable valves into the system may be the limiting factor of the experiment, and otherwise ideal conditions will permit measurement of impurity ratios, e.g. for H_2 in He in the order of $1/10^7$ at best. Author (TAB)

N66-16661# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
THE EVOLUTION OF USAF ENVIRONMENTAL TESTING
Virgil J. Junker Oct. 1965 83 p refs
(AFFDL-TR-65-197; AD-625543) CFSTI: HC $3.00/MF $0.75

This report presents supporting data and background information on the origination and development of natural and induced environmental tests intended for USAF aerospace and ground equipment. The information provided in the discussion portion of the test writeups is intended to give the designer, application engineer, and those individuals responsible for specifying test requirements a clearer understanding of the interpretation, application, and relationship of tests as called out in various environmental test documents. The growth of environmental criteria and test procedures is traced from the first Army Air Force specification No. 41065 dated 7 December 1945 to MIL-STD-810A (USAF) dated 23 June 1964. Included also in this report are discussions on environmental test specifications MIL-T-5422, MIL-E5272, and MIL-E-4970. Author (TAB)

N66-16734# IIT Research Inst., Chicago, Ill.
PHYSICS AND NONDESTRUCTIVE TESTING
R. S. Krogstad et al [1965] 12 p Papers presented at the Symp. on Physics and Nondestructive Testing, Dayton, Ohio, 28–30 Sep. 1965
(AD-624582) CFSTI: HC $1.00/MF $0.50

Presented are abstracts on the following: *Holograms; Electron Emission During Metal Fatigue; Advanced Metal Matrix Composites; Use of the Microprobe Analyzer to Assist NDT Investigations; Surface Residual Stress by Means of Rayleigh Waves; Microfocus Radiography; Optimizing Defect Detection in High Energy X-Radiography; A Comparison Between Thermal, Epithermal, and Subthermal Neutrons for Radiography; The Physics and Chemistry of Color Photography; Optics and Infrared Nondestructive Testing; Reducing Emissivity Errors in Infra-Red Detecting Systems; The Nondestructive Testing of Solid Propellant Rocket Motors;* and *Inspecting Thin Sheet Using Lamb Wave Spectrum Analysis.* E.E.B.

N66-16738# Naval Research Lab., Washington, D. C.
FACTORS AFFECTING THE ICING RESISTANCE OF LUBRICANTS FOR AIRCRAFT ORDNANCE Final Report
H. R. Baker and R. N. Bolster 21 Oct. 1965 38 p refs
(NRL-6329; AD-624594) CFSTI: HC $2.00/MF $0.50

Recent samples of the all-weather semifluid lubricant for aircraft ordnance, both from manufacturers and from Navy stocks, have failed to meet the cold-sweat-cold gun firing test required by Military Specification MIL-L-19701 (NOrd). These failures were due to ice adhesion attendant on the poor water resistance of the lubricants. The probable cause of the loss in water resistance was the presence in the lithium stearate thickener of surface-active impurities such as sodium soaps and soaps of myristic and oleic acids. These impurities can be detected by measurements of surface tension lowering. It is probable that the water resistance of other lithium stearate thickened greases are also affected by these impurities. The investigation established that variations in raw materials other than the soap were not major contributors to the difficulties encountered. A lubricant of altered formulation has been developed and shown to be superior to the original lubricant. Variations in the consistency of the improved lubricant over a wide temperature range were found to be much less than those of the original lubricant. Resistance to water and to ice adhesion are increased. This material has successfully lubricated the Mk 12 machine gun equipped with the Mk 7 penumatic feeder under ambient temperature and cold-sweat-cold conditions. This formulation retains all of the useful properties of the original lubricant, such as compatibility with MIL-P-5516 oil-resistant rubber, resistance to evaporation loss, corrosion inhibition, and antiwear protection. Author (TAB)

N66-16821# Linden Labs., Inc., State College, Pa.
MACHINING HIGH PURITY ALUMINA Quarterly Report No. 3, 1 Jan.–1 Apr. 1965
P. A. Marshall, Jr. 1 May 1965 30 p refs
(Contract DA-36-039-AMC-03634(E))
(Rept.-3; AD-624484) CFSTI: HC $2.00/MF $0.50

It was demonstrated that a pre-selected commercial grade, high-purity alumina (96%) can be made friable by immersion in aqueous hydrofluoric acid (52%) so that it can be machined with conventional cutting tools and then reconstituted to acceptable physical characteristics, i.e., dimensional control, porosity (open and closed pores), water absorption and a high pressure fuchin dye penetration. Further it has been demonstrated that a pre-selected, presently available commercial grade 96% alumina fired at cone 31 (1680°C) can be reconstituted at cone 33 (1745°C) to a purity level suggestive of approaching the theoretical density of alpha corundum (4.00). A basis is given for aiding in the selection of those alumina bodies which are most apt to accommodate to this new technique. Also, it is concluded that for optimizing this process, it might be well to design a body formulation which will adapt itself to this process rather than make use of existing bodies. Factors other than chemical composition, such as the primary raw material grain size and fired grain size, must also be considered. Author (TAB)

N66-16850 Westinghouse Electric Corp., Sunnyvale, Calif.
SOME MANUFACTURING CONSIDERATIONS IN ECONOMICAL MAGNET DESIGN
D. R. Mc Allister and H. W. Miller *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 271–280 refs (See N66-16826 07-23) CFSTI: $8.50

It is imperative for the magnet designer to be aware of the influence of manufacturing techniques on the ultimate cost of the magnet assembly. Selection of core types and coil construction can have a significant effect on costs. Requirements for fine surface finishes and close dimensional tolerances will increase the cost of the finished product. As the ultimate judge of cost vs. function, the magnet designer should be fully aware of the impact that his design decisions will have on the ultimate cost of the product. Author

N66-16851 Westinghouse Electric Corp., Sunnyvale, Calif.
RELIABILITY AND QUALITY CONTROL
L. D. Connell *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 281–286 refs (See N66-16826 07-23) CFSTI: $8.50

An integrated approach must be followed to obtain reliability and quality control as well as to reduce economic waste throughout all phases of the manufacturing process. Causes of unreliability and the basic problems are considered. Reliability is discussed in terms of relationships, disciplines, and goals; the need for inherent reliability in design procedures is emphasized; and a design review reliability check list is presented. Product verification, quality of manufactured products, procurement, and defect analysis are reviewed. Both analytical and control techniques are considered necessary to achieve reliability in the manufacture of heavy electrical equipment. M.W.R.

N66-16854 McGraw-Edison Co., Columbus, Ohio. National Electric Coil Div.
MAGNET COIL FABRICATION
Ben Zimmerman *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 305–312 (See N66-16826 07-23) CFSTI: $8.50

The different operations required in manufacturing good magnet coils are described, and the effect of various methods on the design of better and more economical coils is discussed. The relative merits of coil winding methods are examined, for such variations as winding (1) with the conductor taped or sleeved; (2) with bare conductor with permanent insulation between turns; and (3) with a temporary spacer between turns followed by a permanent insulation of taping, sleeving, or a spacer. In the discussion of hollow conductor splicing, it is recommended that conductors of maximum length be used in order to eliminate as many joints as possible. Test methods for leak checking are listed as helium, and halogen leak testing; pressurizing the coolant passage with nitrogen; and application of hydrostatic pressure to a coil. Also considered are such ground insulation systems as painting, vacuum pressure impregnating, vacuum potting, mica impregnating, and laminated construction. Inspection methods are summarized for turn-to-turn, and ground testing; and an example of the winding, insulating, and testing techniques for a specific coil is included. M.G.J.

N66-16855 Stanford Univ., Calif. Stanford Linear Accelerator Center.
INSULATION STRUCTURE AND COIL RELIABILITY
H. Brechna and E. Oster *In its* Proc. of the Intern. Symp. on Magnet Technol. 1965 p 313–341 refs (See N66-16826 07-23) CFSTI: $8.50

Insulation voids due to impregnation and potting failure, and delamination of insulation due to magneto-mechanical and thermomechanical forces lead frequently to coil deficiencies such as corona, accelerated aging, electrical breakdown between conductors and adjacent pancakes, or flashover from coil magnet core or structural parts. The prevention and evaluation of cavities and the determination of their size and distribution over the coil is a formidable task. However, an approach to determine the stresses on the insulation and corona, ionization effects on the thermoset, and reduction of the corona threshold due to environmental influences is discussed.

Methods of prevention, detection, and evaluation of cavities are given. A nondestructive coil test program to evaluate the soundness of insulation is proposed. Author

N66-16856 California Univ., Berkeley. Lawrence Radiation Lab.

X-RAY EXAMINATION OF SQUARE WATER-COOLED COPPER MAGNET-CONDUCTOR BRAZE JOINTS

Richard A. Nickerson *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 342–348 (See N66-16826 07-23) CFSTI: $8.50

Brazed joint design and fabrication technology has been improved by X-ray quality control in early stages of magnet coil production. The X-ray techniques discussed, although simple, require consideration of geometry and of exposure parameters, particularly kilovoltage. A method is described for proper choice of exposure kV, which permits the high-quality radiographs needed for quality control. The joint design which proved to be most reliably manufactured, under a rigidly controlled process, is discussed. Author

N66-16858 Argonne National Lab., Ill.

FABRICATION TECHNIQUES OF SEVERAL COILS IN THE ZERO GRADIENT SYNCHROTRON COMPLEX

R. R. Roman, F. Markley, and A. Mc Kamey *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 356–365 (See N66-16826 07-23) CFSTI: $8.50

Standard magnetic coil fabrication processes were optimized and incorporated into a special fabrication technique to provide the specialized coils required for precision bending and focusing of the injected beam as well as extraction of the accelerated beam from a zero gradient synchrotron. Several high-current uniform-field magnets were fabricated; and conductor location on the coils, with ground insulation, was held to very close tolerances. While production costs for such magnets are high, performance of the coils has been found to be very good; and the technique has been refined during the production of six achromatic coil halves, three Piccioni coils, and spares. M.W.R.

N66-16859 Oerlikon Machine Tool Works, Zurich (Switzerland).

DESIGN AND CONSTRUCTION OF THE MAGNET AND TRANSPORT SYSTEM FOR A LARGE LIQUID HELIUM BUBBLE CHAMBER

Peter A. Tschopp *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 366–376 refs (See N66-16826 07-23) CFSTI: $8.50

Design and construction is discussed for the magnet and transport system for a liquid helium bubble chamber. The magnet, which consists of a Helmholtz pair of coils and return yoke, has a nominal power of 4 MW at 8000 A, a nominal field of 20 kG, and magnetic weight of approximately 83 t. Coils are hollow copper, directly water-cooled and insulated. The transport system of interchangeable jacks and skates provides for horizontal and vertical movement of the complete 105 t bubble chamber assembly. Three hydraulic jacks permit adjustment of magnetic center height, and three motor-driven skate assemblies can rotate the chamber on a vertical axis as well as move it any direction on the floor. Roller chains make contact to the floor. M.W.R.

N66-16892 Aerojet-General Nucleonics, San Ramon, Calif. Research Div.

DESIGN AND FABRICATION OF INTEGRAL COOLANT PASSAGE CRYOGENIC COILS FOR HIGH POWER DENSITY

Alex Boozenny and J. R. Payne *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 630–642 Sponsored by AF (See N66-16826 07-23) CFSTI: $8.50

Large, unusually oriented mechanical stresses on the solenoidal coils for the adiabatic mirror-cusp plasma containment device eliminated the use of conventional coils. The investigation showed only solid, unsegmented coils could withstand these stresses. Analytical studies showed that tapered slots through the radial thickness of unsegmented coils was the most satisfactory means for providing sufficient heat transfer area within the coils without seriously affecting their mechanical strength. This coil type is referred to as the integral coolant passage coil, and can be operated at higher current densities than equivalent hollow square conductor coils. Cryogenic coils are being wound on a machine that operates semiautomatically to properly index the punching of the slots to form non-involuted, tapered coolant passages. The pilot model for this large-scale winding machine is fully automatic and has produced usable coils of twenty inches diameter with non-involuted, straight coolant passages. These coils are superior to similar sized hollow square conductor coils. Author

N66-16915# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany).

THE STRENGTH OF METAL-BONDED-LAP-JOINTS AT LOW AND HIGH TEMPERATURES AND AFTER CYCLES OF TEMPERATURES [DIE FESTIGKEIT VON UBERLAPPTEN METALLKLE-BUNGEN BIE TIEFEN UND HOHEN TEMPERATUREN UND NACH TEMPERATURWECHSELN]

W. Althof Sep. 1965 53 p refs In GERMAN; ENGLISH summary

(DCR-FB-65-46) CFSTI: HC $3.00/MF $0.50

Bonded single lap joints have been tested at temperatures of −195°C up to +300°C for short-time and long-time loading, and at temperature cycles between −25°C and +90°C or +150°C respectively. The test results are useful for the selection of adhesives acting in certain temperature ranges. Correlations between the shear strength and the joint-factor are established. Author

N66-16947 Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia). National Standards Lab.

TOOL-LIFE EXPONENTS IN THE LIGHT OF REGRESSION ANALYSIS

R. T. Leslie and G. Lorenz 1964 34 p refs Presented at the 12th Gen. Assembly of the Intern. Inst. of Production Eng. Res. (C.I.R.P.), The Hague, 1962 *Its* Tech. Paper No. 20 CFSTI: HC $2.00/MF $0.50

Examples of the use of regression analysis are given to encourage production engineers to use statistical methods. It is shown that this technique is particularly suitable for the evaluation of production data where neither the observation levels nor the number of observations can be kept constant. The most important statistical terms are explained, without mathematical derivations, in the language of the production engineer. Regression methods are used to analyze experimental data on the variation of the tool-life exponent when machining six heats of hot-rolled CS 1114 free-cutting steel in conventional turning tests. It is shown that large variations in the value of the tool-life exponent may be explained as chance effects. In the past, significance has been attributed to such random variations, and this has led to unjustifiable conclusions. It is shown that the method of regression analysis

gives a lead to further investigations. In this particular case, it suggests the possibility of using a quick test for the assessment of machinability ratings of free-cutting steels. Author

N66-16953# Joint Publications Research Service, Washington, D. C.
TESTING FOR CRACKS WITH PARAMAGNETIC FLUORESCENT TESTING MEDIA
C. G. Nestler 9 Feb. 1966 11 p refs Transl. into ENGLISH from Die Technik (East Berlin), v. 20, no. 11, Nov. 1965 p 725–727
(JPRS-34066; TT-66-30508) CFSTI: $1.00

An ultraviolet-orange new fluorescent test past increases the reliability of crack detection tests by about 20%. Testing time is relatively short, and the disadvantages of a magnetic powder test are eliminated. A discussion is included of the principle of testing for cracks, and illustrations relate directions of magnetic lines for various types of cracks. M.W.R.

N66-16973*# Ohio Univ., Athens. Coll. of Engineering and Technology.
LEAK DETECTION TECHNIQUE IMPROVEMENT STUDY FOR SPACE VEHICLES Interim Report No. 1, Apr. 7, 1964–Apr. 7, 1965
Apr. 1965 101 p refs
(Contract NAS8-11199)
(NASA-CR-70179) CFSTI: HC $4.00/MF $0.75 CSCL 13H

An updating of the state-of-the-art in leak detection methods has been made and is reported. The time-sharing halogen gradient detector developed under this contract is described in detail. In addition, proposed methods of improvement in the standard ionization diode currently underway are described herein. The vibrating capacitor has also been under continuing investigation as a tracer gas detector. In addition, test results and conclusions concerning the use of the radioactive isotope, americium 241, are described. Acoustical methods for leak detection are being studied as described. This approach may well lead to a more sophisticated system to reinforce the presently operable tracer gas method. The identification of sound-injected energy by correlation detection methods looks promising at this point in the development. The state-of-the-arts survey indicates that the transistor microphone will soon be available. Conclusions and recommendations are presented as the distillation of the suggestions which have come to light in the course of these investigations. Author

N66-17043# Corning Glass Works, Bradford, Pa. Electronics Div.
APPLICATION OF OPTICAL FABRICATION TECHNIQUES TO THE FABRICATION AND DEVELOPMENT OF FLUID AMPLIFIERS AND FLUID CIRCUITS, 1 APRIL 1962–31 MAY 1965
R. W. Van Tilburg, R. H. Bellman, and W. L. Cochran 29 Oct. 1965 138 p
(Contract DA-49-186-ORD-1076)
(AD-624773) CFSTI: HC $4.00/MF $1.00

Results from a program of design, fabrication, and evaluation of pressure proportional fluid amplifiers, gain blocks, and circuits are presented. Included is a brief discussion of the development of a multi-stage, high amplification gain block, and from this device, the development of a rudimentary pneumatic analog scale changer incorporating feedback, plus the matching of linear pneumatic resistances. The general conclusions to be drawn from the program are that the design and fabrication of functional, analog pure fluid computational circuits is feasible, that multi-stage gain blocks incorporating the basic HDL pressure gain design, or some relatively minor modification thereof, are capable of pressure gains well in excess of 10000, and that Fotoceram glass ceramic fluid amplifiers and the process for producing them have been developed sufficiently to permit the fabrication and evaluation of complex circuitry. TAB

N66-17111*# Frankford Arsenal, Philadelphia, Pa.
PROCESS DEVELOPMENT OF SHAPED MAGNESIUM-LITHIUM CASTINGS
Anthony Saia and Ralph E. Edelman Nov. 1965 28 p refs
(NASA Order H-71508)
(NASA-CR-70337; R-1785) CFSTI: HC $2.00/MF $0.50 CSCL 13H

A process has been developed for successfully casting a number of prototype aerospace components using the ternary magnesium–lithium–silicon alloy. These components contained many of the design elements anticipated in aerospace hardware of this type. It was found that conventional magnesium sand foundry practice was not satisfactory. A new molding material, based upon bentonite-bonded graphite powder, was employed. Melting and pouring practice was also modified to cope with the reactive nature of the alloy. The radiographic quality of the castings and mechanical properties of test bars sectioned from the castings were evaluated and found to be satisfactory and to correspond with earlier experience on separately cast test bars. Author

N66-17164# College of Aeronautics, Cranfield (England). Dept. of Production and Industrial Administration.
ELECTRO-CHEMICAL MACHINING
D. A. Glew and C. F. Noble Feb. 1965 67 p refs
(COA-Note-M&P-7) CFSTI: HC $3.00/MF $0.75

This paper reports the electrochemical machining process and the requirements which must be considered for its installation on the shop floor. Although only electrochemical shaping is dealt with, many of the parameters investigated are fundamental to other configurations. The machining characteristics of several high strength alloys and die steels have been investigated; also of aluminum and mild steel. Electrolyte heating effects and the physical attributes of the machined surface have been considered. Electrode and workpiece shapes have been simulated for static field examinations and these followed by investigations under dynamic machining conditions. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N66-16210# Westinghouse Electric Corp., Baltimore, Md. Aerospace Applied Physics Group.
DEVELOPMENT OF MILLIMETER AND SUBMILLIMETER MASER DEVICES Interim Report No. 8, 1 Jul.–31 Oct. 1965
W. E. Hughes and C. R. Kremenek Nov. 1965 21 p refs
(Contract AF 33(657)-10472)
(Rept.-490H; AD-623807) CFSTI: HC $1.00/MF $0.50

The investigation of an iron (Fe^{3+}) doped rutile zero field maser amplifier was completed. Further investigations of this device will be conceived with its characteristics as a

solid-state oscillator. Experiments to develop a 94-ghz push-pull maser were conducted during this period; however, it was not possible to produce significant net gain because of a lack of sufficient pumping power. Investigation of X-band zero field masers was continued during this period using polycrystalline iron-doped aluminum chloride. Author (TAB)

N66-16411# Hughes Research Labs., Malibu, Calif.
DISPERSION EFFECTS IN LASER AMPLIFIERS Final Scientific Report, 1 Oct. 1964–30 Sep. 1965
George F. Smith, Wilbur P. Brown, Jr., and Concetto R. Giuliano [1965] 108 p refs
(Contract AF 49(638)-1439)
(AFOSR-65-2211; AD-623849) CFSTI: HC $4.00/MF $0.75

It has been shown that the Rytov approximation is severely limited in its applicability to long distance optical propagation in the atmosphere. A new and powerful boundary layer calculational technique has been developed and applied to the problem of scattering of electromagnetic waves from convex cylinders near grazing incidence. Multigigacycle acoustic waves were generated in crystalline solids by giant pulse ruby laser radiation; several unsuccessful attempts were made to probe these waves with Bragg-scattered gas laser radiation. However, multiple wavelength shifts in stimulated Brillouin scattering from quartz were observed; it was established, by time resolved interferometry, that these shifts result from an iterative process. Author (TAB)

N66-16473# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A CONCEPTUAL MODEL OF THE BACK-SCATTERED FIELD OF LASERS AND THE USE OF THAT MODEL FOR ROTATION DETECTION
Edward Phillip Martin and Robert Ray Sipes (M.S. Thesis, Air Univ.) Aug. 1965 80 p refs
(GE/EE/65-13; AD-622425) CFSTI: HC $3.00/MF $0.75

With the use of a laser, it is possible to measure rotation of a remote object by two techniques: Rotation can be measured by the laser back-scattered field technique and the Doppler spectrum technique. The motion of the back-scattered field was investigated and found to be related to the motion of the target surface. A surface model was developed for the explanation of all experiments performed on the back-scattered field. From preliminary work on the Doppler spectrum, two side results were obtained: (1) a method was discovered to heterodyne the Doppler signal without an external interferometer and (2) a method to measure rotation by the Staas effect (AD-608 087) was demonstrated. Work on the Doppler technique was not completed because of variations in the target speed. Author (TAB)

N66-16656# Rochester Univ., N. Y. Inst. of Optics.
TIME RESOLVED SPECTROSCOPY AND INTERFEROMETRY ON LASER RODS. APPENDIX I AND II Final Report, 1 Sep. 1962–30 Nov. 1964
Michael M. Hercher Jun. 1965 136 p refs
(Contract AF 19(628)-2360)
(AFCRL-65-467; AD-620185) CFSTI: HC $4.00/MF $1.00

CONTENTS:

1. TIME RESOLVED SPECTROSCOPY AND INTERFEROMETRY ON LASER RODS. APPENDIX I: [HIGH SPEED PHOTOGRAPHY AND INTERFEROMETRY ON LASER RODS] Final Report, 1 Sep. 1962–30 Nov. 1964 M. M. Hercher 33 p refs (See N66-16657 07-16)

2. TIME RESOLVED SPECTROSCOPY AND INTERFEROMETRY ON LASER RODS. APPENDIX II: A STUDY OF THE EMISSION FROM A TRAVELING WAVE RUBY LASER Final Report, 1 Sep. 1962–30 Nov. 1964 C. B. Smoyer 99 p refs (See N66-16658 07-16)

N66-16657# Rochester Univ., N. Y. Inst. of Optics.
TIME RESOLVED SPECTROSCOPY AND INTERFEROMETRY ON LASER RODS. APPENDIX I: [HIGH SPEED PHOTOGRAPHY AND INTERFEROMETRY ON LASER RODS] Final Report, 1 Sep. 1962–30 Nov. 1964
Michael M. Hercher *In its* Time Resolved Spectry. and Interferometry on Laser Rods Jun. 1965 33 p refs (See N66-16656 07-16) CFSTI: HC $4.00/MF $1.00

This report describes investigations carried out on solid state laser phenomena in two different areas. (1) High speed photography of near field phenomena in the radiation from several ruby lasers shows quite clearly the very complex distribution of intensity both in space across the face of the ruby and in time (spiking). (2) Time resolved interferometry has been carried out on laser rods under pump conditions, but without lasing, to observe effects of heating by the pump radiation. An important feature of these observations is a temporary distortion of the optical path through the outer portions of the laser rod, requiring a recovery time of several seconds for glass and a fraction of a second for ruby. Author

N66-16658 Rochester Univ., N. Y. Inst. of Optics.
TIME RESOLVED SPECTROSCOPY AND INTERFEROMETRY ON LASER RODS. APPENDIX II: A STUDY OF THE EMISSION FROM A TRAVELING WAVE RUBY LASER Final Report, 1 Sep. 1962–30 Nov. 1964
Claude Benzing Smoyer (M.S. Thesis) *In its* Time Resolved Spectry. and Interferometry on Laser Rods Jun. 1965 99 p refs (See N66-16656 07-16) CFSTI: HC $4.00/MF $1.00

Evidence of spectral narrowing in the output of a traveling wave ruby laser is presented. A comparison of equivalent traveling and standing wave cavities shows that for similar excitation, spectral narrowing of better than a factor of four can be achieved. However, multimoding in this experimental arrangement is still strongly evident. Results of preliminary experiments in Q switching the traveling wave cavity are also presented. These results are inconclusive, but do show the need for a more sophisticated experimental procedure for obtaining optimum results from a Q switched traveling wave laser cavity. Author

N66-16742 Stanford Univ., Calif. Microwave Lab.
SPECTRAL CHARACTERISTICS OF LASER OSCILLATORS
In its Laser Mater. (Spectry.) Jul. 1965 p 34–118 refs (See N66-16740 07-26) CFSTI: HC $4.00/MF $1.00

A review and synthesis of the previous literature on oscillator spectra, with particular emphasis on laser oscillators, is presented. The below-threshold oscillation spectral width, Δf_{osc}, is derived:

$$\Delta f_{osc} = \frac{2\pi kT\ \Delta f^2}{P_{osc}} ,$$

where Δf = bandwidth of the passive circuit without the negative conductance, P_{ocs} = total noise power output from the

oscillator. The above-threshold spectral width due to phase fluctuations in the oscillator output is

$$\Delta f_{osc_{PM}} = \frac{\pi kT\,\Delta f^2}{P_{osc}}.$$

The above-threshold spectral width due to amplitude fluctuations (the AM contribution to the spectral width) is $\Delta f_{AM} = G_1/2\pi C$, where G_1 is an equivalent conductance defined in the report. A practical Nd:YAG CW laser system has been designed and built. An aluminized glass, cylindrical cavity was used, and a linear tungsten filament, ASA-DXN 1000 watt lamp was used as an optical pump. The laser threshold was between 900 and 1000 watts. Author

N66-16812 Joint Publications Research Service, Washington, D. C.
TRANSMISSION CHARACTERISTICS OF THE ND^{3+} LASER
Fu-Hsi Kan, Ying-Shih Ts'ai, Chung-Hung Chiang Hsi-Shan Li, and Ch'eng-Fu Li *In its* Transls. on Communist China's Sci. and Technol. 17 Jan. 1966 p 138–151 refs (See N66-16806 07-34) CFSTI: $6.:0

An aluminum glass laser was studied for its transmission spectrum and oscillating characteristics, Nd^{3+} ion density, glass composition and uniformity and their influences on resonance reflectivity and output energy, and finally the characteristics of the glass laser. Measurements of the width of the excited spectrum established its dependence on the output energy; excited laser transmission was composed of many small pulses, with the pulse density inversely proportional to the oscillating time. A comparison of seven different silicon salt glasses of different ion densities showed that at low densities the Md_2O_3 composition increased, but quantum efficiency and fluorescent life time did not change much. At high density, quantum efficiency and fluorescent life time decreased noticeably. The long life time of silicon salted glasses, and the spectrum width of boric salted glasses were found superior to aluminum phosphate salted glasses for their transmitting parameters. G.G.

N66-16987*# College of William and Mary, Williamsburg, Va.
MEASUREMENT OF LIGHT SCATTERED FROM A LASER BEAM BY THE ATMOSPHERE Semiannual Status Report No. 3, Jun. 1–Nov. 30, 1965
James D. Lawrence, Jr. [1965] 16 p
(Grant NsG-710)
(NASA-CR-70177) CFSTI: HC $1.00/MF $0.50 CSCL 20E

A workable laser system was delivered, and a number of backscatter measurements made. The observations made to date have been made with the laser system operating at about 20% efficiency and with neutral density filters (attenuation factor: about 100) ahead of the receiving optics. Even so excellent backscatter observations of the lower atmosphere to about 30 km have been made and clearly indicate the aerosol structure of the lower atmosphere. Several examples of these measurements are included in this report. In addition, theoretical analysis of the problem is proceeding. Author

N66-17001# General Precision, Inc., Pleasantville, N. Y. Aerospace Group.
PUMPED TRANSFORMER LASERS Technical Summary Report No. 2, 1 May–1 Nov. 1965
Cecil B. Ellis, James H. Simpson, and Donald S. Bayley 22 Nov. 1965 85 p refs
(Contract Nonr-4718(00); ARPA Order 306; Proj. Defender)
(GPL-A-31-2; AD-624481) CFSTI: HC $3.00/MF $0.75

Most of the analysis in this period has dealt with use of metastable nitrogen molecules as the active medium for a transformer laser to be pumped by a battery of Nd glass auxiliary lasers. It was concluded that such a medium would be operable, but that adequate data are not at hand to produce optimism on reaching maximum output pulse energy densities in the nitrogen greater than the region of one joule/cc, with satisfactory maintenance of optical beam quality. An extension of previous analysis on a similar use of cn molecules indicates that this medium might be expected to yield satisfactory outputs around one joule/cc or somewhat greater. From the meager information available today, it appears that diatomic cesium molecules might possibly surpass cn and constitute the best medium for transformer action with Nd glass laser pumping. An experimental attack on some of the many remaining unknowns regarding Cs_2 is now underway, and first preliminary tests are reported. A beginning has been made toward mathematical spatial analysis of the higher power flux patterns to be expected within a heavily pumped transformer medium. Author

N66-17006# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
CONTINUOUS-WAVE STIMULATED RAMAN EMISSION Semiannual Technical Summary Report, May–31 Oct. 1965
Marvin C. Tobin Nov. 1965 30 p refs
(Contract Nonr-4847(00); ARPA Order 306; Proj. Defender)
(PE-TR-8186; AD-624301) CFSTI: HC $2.00/MF $0.50

A total of twenty-five organic liquids were examined in this measurement series. Stimulated Raman emission was observed in twenty-one organic liquids. In none of these was the strongest line near 1057/cm, the frequency needed for continuous wave generation of stimulated Raman emission. In spontaneous Raman emission, however, three compounds were observed to have strong lines near 1057/cm and will be used in the continuous wave experiment. Spontaneous line halfwidths were measured in some of these compounds. A one-meter tank with glass walls was constructed and used with a Q-switch ruby laser to (1) observe light scattering in water and in organic liquids (2) look for effects ascribable to electrostriction and (3) measure a gain of 0.05/cm for the 1004/cm line of toluene in sample lengths of 50–100 cm. The light scattered to the side showed discrete scattering sites to be present. No effects definitely ascribable to electrostriction could be observed. Author (TAB)

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17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N66-16193*# Materials Research Lab., Inc., Richton Park, Ill.
ELEVATED TEMPERATURE STRESS CORROSION OF HIGH STRENGTH SHEET MATERIALS IN THE PRESENCE OF STRESS CONCENTRATIONS Final Report

E. J. Ripling, R. L. Kirchner, R. P. O'Shea, and R. G. Lingwall Nov. 1965 47 p refs
(Contract NASr-50)
(NASA-CR-69851) CFSTI: HC $2.00/MF $0.50 CSCL 11F

CONTENTS:
1. THE DIFFUSION OF CORROSION PRODUCTS IN HOT SALT STRESS-CORROSION CRACKING OF TITANIUM p 2–19 refs (See N66-16194 07-17)
2. ELECTROCHEMICAL ASPECTS OF HOT SOLID SALT STRESS CORROSION CRACKING OF TITANIUM BASE ALLOY p 20–35 refs (See N66-16195 07-17)
3. MISCELLANEOUS EXPERIMENTS p 36–39

N66-16194* Materials Research Lab., Inc., Richton Park, Ill.
THE DIFFUSION OF CORROSION PRODUCTS IN HOT SALT STRESS-CORROSION CRACKING OF TITANIUM
In its Elevated Temp. Stress Corrosion of High Strength Sheet Mater. in the Presence of Stress Concentrations Nov. 1965 p 2–19 refs (See N66-16193 07-17) CFSTI: HC $2.00/MF $0.50

An experimental technique is described for separating the gaseous, liquid and solid reaction products generated by the hot salt corrosion of titanium. By use of this procedure, it is shown that the product that causes cracking is not a gas, and hence would not be expected to be washed away by a fast moving air stream in service. Author

N66-16195* Materials Research Lab., Inc., Richton Park, Ill.
ELECTROCHEMICAL ASPECTS OF HOT SOLID SALT STRESS CORROSION CRACKING OF TITANIUM BASE ALLOY
In its Elevated Temp. Stress Corrosion of High Strength Sheet Mater. in the Presence of Stress Concentrations Nov. 1965 p 20–35 refs (See N66-16193 07-17) CFSTI: HC $2.00/MF $0.50

It is shown that the corrosion of titanium in the presence of hot solid salt occurs due to an oxygen differential cell. Cracking always occurs at the cathode of this cell, and the cracking can be prevented by impressing an anodic current on the stressed specimens. Author

N66-16220# India. Dept. of Atomic Energy, Bombay. Chemistry Div.
DIFFUSION BONDING BETWEEN ALUMINIUM AND NICKEL
B. M. Pande, S. P. Murarka, and R. P. Agarwala 1964 17 p refs
(AEET/CD/26) CFSTI: HC $1.00/MF $0.50

Solid state diffusion bonding of aluminum and nickel couples was studied at annealing temperatures of 400° to 600°C over a period of 8 to 20 days. Samples were prepared by pressing cleaned and polished aluminum plugs into holes of nickel specimens, followed by sealing of the couples in Pyrex and silica tubes under reduced pressure of pure argon. Annealed samples were air quenched, etched, and measured by X-ray diffraction method for their diffusion band characteristics. Only the $NiAl_3$ phase formed at shorter annealing periods; diffusion at longer exposures produced $NiAl_3$ and Ni_2Al_3 phases. The total intermetallic layer thickness increased gradually during 400° to 500°C annealing temperatures and reached the highest value of 7.859 at 600°C after a 20 day exposure. It was concluded that once the nucleation of the α-phase starts it grows at the expense of the β-phase, thus reducing the band width of the latter as the period of annealing is increased. G.G.

N66-16224# Library of Congress, Washington, D. C. Aerospace Technology Div.
LIQUID STATE OF METALS Surveys of Communist World Scientific and Technical Literature
Dimitri Vvedensky 29 Oct. 1965 47 p refs Annotated bibliography
(ATD-B-65-95)

This annotated bibliography was compiled from Soviet-Satellite open sources published 1964–1965. It is the first in a series. The report is divided into two sections with data published in 1964 making up the first and data published in 1965 comprising the second. Information covered includes the following: selenium, iron, chromium, silicon, rare earth elements, nickel, sodium alloys, antimony–bismuth system, copper, cadmium–bismuth alloy, lead–tin alloy, magnetic susceptibility, germanium, liquid metal structure, sulfur, aluminum, electrode polarization, liquid metal self-diffusion, electrotransfer, indium–antimony alloys, temperature resistivity, liquid alkali metals, radiation scattering, melt density, thermochemistry, tin, Hall constant, liquid eutectics, X-ray diffraction analysis, steel, electroconvective diffusion, germanium alloys, electrokinetic effect, titanium, ultrahigh pressure melting, zirconium, aluminum oxide wetting, lead, cobalt–silicon system. Author

N66-16260# Joint Publications Research Service, Washington, D. C.
STUDIES IN DIFFUSION COATINGS OF METALS
G. V. Samsonov 26 Jan. 1966 36 p refs Transl. into ENGLISH from Diffuzionnyye Pokrytiya Na Metallakh (Kiev), 1965 p 109–115, 120–142
(JPRS-33902; TT-66-30345) CFSTI: HC $2.00

High frequency induction heating at 850° to 1100°C was used to saturate titanium alloy samples with carbon and nitrogen and thus improve their surface layer hardness. Carbidizing and nitridizing improved titanium resistance to wear considerably, while nitriding increased its heat resistance. Measurements of voltage drop in the electrical contact of titanium with diffusion deposited layers of carbide, boride, or nitride and also of unprotected titanium surfaces with different electrical engineering materials showed a lower voltage drop across the contacts of titanium specimens covered by electrically conductive refractory compounds. It was found that the electrical contact of graphite with titanium electric lead is satisfactory and can replace any of the now used leads. Scale stability, resistance to wear, and chemical stability of diffusion deposited carbide and boride coatings on titanium, zirconium, molybdenum, as well as tungsten and boride coatings on niobium were also studied and results are shown graphically. G.G.

N66-16262# European Atomic Energy Community, Brussels (Belgium).
COMPUTER ANALYSES OF TENSILE TESTS
D. J. Boerman, P. Bonnet, M. Grin, and A. Hubaux Sep. 1965 58 p refs
(EUR-2514.e) CFSTI: HC $3.00/MF $0.50

Several graphical representations of the tensile test are described and two well-known laws are verified in these graphs—the law of Hooke in the elastic region, and the law of Ludwig in the strain-hardening region. Tensile tests of SAP, pure aluminium and aluminium alloys were executed on an Instron machine, at different temperatures. In order to obtain a higher accuracy, several strain-measuring methods were applied and compared. Only with the aid of an IBM 7090 computer and a dataplotter was it possible to obtain 36 parameters

and 7 curves from each test in a very short time. We show the advantages of time saving, decrease of human errors, plus an increase of quantity and quality of information. Author

N66-16304# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
TITANIUM AND TITANIUM ALLOYS—REVIEW OF RECENT DEVELOPMENTS
R. H. Ernst and R. A. Wood 9 Oct. 1964 4 p refs

Cryogenic properties and room and elevated temperature behavior are discussed for titanium and titanium alloys in a brief review of recent developments. Average tensile properties obtained at −423°F are tabulated for ELI grades of titanium alloys, as are properties of one-inch plate in selected heat-treated conditions and endurance life of tubing in pressure-cycling and vibration-fatigue tests. Studies on the Ti-3Al-2.5V tubing indicate that tubing size as well as test technique affect endurance life. M.W.R.

N66-16313# Battelle Memorial Inst., Columbus, Ohio.
STUDIES OF REACTIONS OCCURRING DURING BETA HEAT TREATMENT OF TITANIUM Final Report
J. J. English, D. N. Williams, and H. R. Ogden 14 May 1965 68 p refs
(Contract N161-25953)
(AD-615633) CFSTI: HC $3.00/MF $0.75

Thermal dilation anomalies occur when certain titanium alloys are repeatedly cycled through the allotropic transformation. These anomalies were related to the orientations of the alpha and beta phases which form during the transformation. On heating or cooling the Ti-7Al-3Cb-0.06 O_2 and Ti-7Al-3Cb-0.12 O_2 alloys through the transformation temperature range, the thermal dilation curves may show an expansion, contraction, or no discontinuous length change, depending on the orientation of the phases. The type of expansion behavior may have a significant effect both on toughness and weldability. Impact strengths of the 7Al-3Cb titanium alloys at −80° F can be improved 3 to 5 foot-pounds by slowly heating and cooling the alloys through the transformation in vacuum. This improved impact strength is believed to be related to a decrease in hydrogen content. Author (TAB)

N66-16380*# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy.
EFFECTS OF HYDROSTATIC PRESSURE ON THE MECHANICAL BEHAVIOR OF BODY CENTERED CUBIC REFRACTORY METALS AND ALLOYS Interim Technical Report No. 3
S. V. Radcliffe Dec. 1965 28 p refs
(Grant NsG-654)
(NASA-CR-69857) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Measurements of the influence of hydrostatic pressures up to 25 kilobars on the terminal ductile–brittle transition temperature of powder metallurgy tungsten wire of commercial purity have been carried out for annealing temperatures of 1310°C and 1600°C. The transition temperatures (80°C and 190°C respectively) for these vacuum annealed conditions are unaffected. Analogous observations for a tungsten–1% thoria alloy vacuum annealed at 2000°C and 2200°C showed no measurable change in T_d (130°C and 180°C respectively) on pressure cycling. The optical microstructures indicate that, even at 2200°C, the fiber structure is not completely removed. Tests on annealed specimens of a Fe–0.065° C alloy cycled up to 20 kilobars show the expected successive lowering of the stress for yielding and the elimination of the upper yield point. Author

N66-16420*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF BORON ADDITIONS ON PHYSICAL AND MECHANICAL PROPERTIES OF ARC-MELTED TUNGSTEN AND TUNGSTEN–1 PERCENT TANTALUM ALLOY
Peter L. Raffo and William D. Klopp Washington, NASA, Feb. 1966 22 p refs
(NASA-TN-D-3247) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The effects of boron additions on the physical and mechanical properties of arc-melted tungsten and a tungsten–1 percent tantalum alloy were investigated. Boron additions significantly refined the as-melted grain size of tungsten. The 1-hour recrystallization temperature was initially increased by small boron additions (approx 0.01 atomic percent boron), after which it decreased continuously with increasing boron content. High-temperature tensile tests showed that the boron additions produced an initial rapid rise in strength followed by a leveling off of the strength-composition curve. Boron in solid solution was postulated to be the cause of the rapid increase in strength. Author

N66-16451# Bureau of Mines, College Park, Md.
CORROSION PROPERTIES OF MOLYBDENUM, TUNGSTEN, VANADIUM, AND SOME VANADIUM ALLOYS
Walter L. Acherman, J. P. Carter, C. B. Kenahan, and David Schlain 1966 73 p refs
(BM-RI-6715)

Molybdenum, tungsten, and vanadium were found by the Bureau of Mines to possess generally superior chemical and galvanic corrosion properties in many aqueous corrosion media at temperatures up to the boiling point. The corrosion resistance of vanadium in certain solutions was further improved by alloying it with such metals as columbium, tantalum, and titanium. Tungsten was susceptible to a type of crevice corrosion in mercuric chloride solutions, but no other instances of crevice corrosion were encountered. With few exceptions, molybdenum, tungsten, and vanadium were not adversely affected when coupled with dissimilar metals in galvanic corrosion experiments; in some cases one or both members of a couple were protected by contact. When exposed to aqueous ammonia spray at 60°C, all three metals were moderately attacked, but they were resistant in spray environments of substitute ocean water and ammonium dihydrogen phosphate. Author

N66-16483# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
STUDY OF DIFFUSION OF CARBON AND MOLYBDENUM IN CHROMIUM
P. L. Gruzin, S. V. Zemskii, and I. B. Rodina Mar. 1965 15 p refs Transl. into ENGLISH from Met. i Metalloved. Chistykh Metal. (Moscow), no. 4, 1963 p 243–250
(AERE-TRANS-1032) HMSO: 1s 9d

Diffusion of both carbon and molybdenum in chromium is studied to investigate the role diffusion processes play in the failure of protective coatings. The diffusion coefficients of molybdenum in chromium were studied by the methods of stripping layers and measuring the integral radioactivity. Two methods are described for determining the diffusion coefficients of carbon in chromium. The temperature dependence of the diffusion coefficients of molybdenum for chromium and nickel are determined and the temperature dependence obtained for the coefficient of carbon in chromium is compared with the corresponding relationship for α-iron. It is also established that the level of the diffusion mobility of carbon in chromium is much lower than in iron. M.R.W.

N66-16486*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

DEVELOPMENT OF A PHOTOELASTO-PLASTIC METHOD TO STUDY STRESS DISTRIBUTIONS IN VICINITY OF A SIMULATED CRACK—PHASE I AND II

A. R. Hunter Oct. 1965 59 p refs

(Contract NAS1-4760)

(NASA-CR-66039; LMSC-4-05-65-11) CFSTI: HC $3.00/MF $0.50 CSCL 11F

A new photoelasto-plastic technique is presented. This method utilizes the creep characteristics of polymer materials at elevated temperatures to simulate stress-strain behavior of aluminum alloys. Through the use of frozen stress and slicing procedures, the technique has been applied for three-dimensional stress analyses. An evaluation of the method has been made through the study of flat specimens containing a central hole. Several ratios of thickness to hole diameters and several levels of local plasticity were investigated. A close correlation was found between the experimental results and theoretical analyses. Author

N66-16487# Aeronautical Research Council (Gt. Brit.)

EFFECT ON THE STATIC STRENGTH OF ALUMINIUM ALLOY TEST SPECIMENS OF THE ATTACHMENT OF THERMOCOUPLES BY A WELDING TECHNIQUE

D. F. Wright and G. F. Acheson London, HMSO, 1965 38 p Supersedes RAE-TN-STRUCT-345; ARC-25921

(CP-790; RAE-TN-STRUCT-345; ARC-25921) HMSO: 6s 6d

Tensile tests were made on a large number of aluminum alloy test specimens extracted from sheet material to determine the effect of attaching thermocouple leads to them by a welding technique. The tests showed that the thermocouple welds had a negligible effect on the proof and ultimate stresses and on Young's Modulus. There was, however, a marked tendency for the specimens to fail at the thermocouple welds with considerable decrease in the elongation at fracture. The reduction of elongation and failure at the weld suggests that it would be prudent to avoid the welding method of thermocouple attachment for specimens where the measurement of elongation at fracture is required, and for specimens and structural parts subject to fatigue load, but this method is recommended for calibration of other temperature measuring devices, including thermocouples attached by other means. Author

N66-16551*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

MECHANICAL PROPERTIES OF SOLID-SOLUTION AND CARBIDE-STRENGTHENED ARC-MELTED TUNGSTEN ALLOYS

Peter L. Raffo and William D. Klopp Washington, NASA, Feb. 1966 37 p refs

(NASA-TN-D-3248) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The mechanical properties of several arc-melted tungsten alloys containing rhenium, tantalum, columbium, hafnium and/or carbon were investigated in the temperature range 2500° to 4000°F. Solid-solution strengthening in tungsten alloys was most effective in tungsten–hafnium alloys and least effective in tungsten–rhenium alloys. Carbon additions to unalloyed tungsten produce a minimum in the tensile-strength carbon-content curve. Carbon additions to tungsten–columbium, tungsten–tantalum, tungsten–tantalum–rhenium, and tungsten–hafnium alloys produced various degrees of strengthening with the largest effect found in the tungsten–hafnium–carbon alloys. The differences in strength between the various carbide-strengthened alloys were a result of the differences in the carbide particle size, where the finest particle size was observed in the tungsten–hafnium–carbon alloys. The strongest alloy, tungsten–0.20 atom percent hafnium–0.26 atom percent carbon, had a tensile strength of 62 500 pounds per square inch at 3500°F in the as-swaged condition, and recrystallized only after annealing for 4 hours at 4200°F. Author

N66-16556*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EXPERIMENTAL INVESTIGATION OF PARAMETERS AND MATERIALS FOR FRAGMENTING-TUBE ENERGY-ABSORPTION PROCESS

John R. Mc Gehee Washington, NASA, Feb. 1966 38 p refs

(NASA-TN-D-3268) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The results of this investigation indicate that the average fragmenting stress of 2024-T3 aluminum-alloy tubing varies directly as the cube root of the tube-inside-diameter–die-forming-radius ratio and inversely as a function of the tube-wall-thickness–die-forming-radius ratio. The average fragmenting stress for 2024-T3 aluminum-alloy tubing computed from a derived empirical equation is in fair agreement with the experimental data for the range of parameters investigated. The maximum value of the average fragmenting stress may be obtained when the magnitude of the stress fluctuations about the average value is a minimum and when the largest values of tube-wall-thickness–die-forming-radius ratio and tube-inside-diameter–die-forming-radius ratio are employed. The fragmenting of tubes of 2024-T3 aluminum alloy, 7075-T6 aluminum alloy, AZ31B magnesium alloy, and chrome–molybdenum steel (AISI 4130) in a cold-water-quenched condition has been demonstrated. The results of the brief materials investigation indicate that the energy-absorption capability of the fragmenting of tubes of various materials generally increases with increasing material yield stress. The AISI 4130 steel was the most efficient tubing on the basis of energy-absorption capability per pound force (N) of material. Author

N66-16575*# National Aeronautics and Space Administration, Washington, D. C.

STUDYING THE PHASE COMPOSITION OF METEORITIC IRON BY THE LOCAL X-RAY SPECTRAL ANALYSIS METHOD [IZUCHENIYE SOSTAVA FAZ METEORITNOGO ZHELEZA METODOM LOKAL'NOGO RENTGENOSPEKTRAL'NOGO ANALIZA]

A. A. Yavnel', I. B. Borovskiy, N. P. Il'in, and I. D. Marchukova Dec. 1965 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Astron. (Moscow), v. 123, no. 2, 1958 p 256–257

(NASA-TT-F-9815) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The article discusses an investigation of the place composition of meteoritic iron to determine origin. Chemical composition, lattice parameters, and phase microhardness are discussed, and heterogeneities are considered. The 1938 Chebankol meteorite is analyzed, and the Widmanstätten structure is included. Author

N66-16652# North Carolina State Coll., Raleigh. Dept. of Engineering Research.

TERNARY INTERSTITIAL COMPOUNDS OF BORON AND NITROGEN WITH TRANSITION AND POST-TRANSITION METALS Final Report, 15 Sep. 1961–15 Sep. 1964

H. H. Stadelmaier 15 Dec. 1965 9 p refs

(Grant DA-ARO(D)-31-124-G94)

(AROD-3138-18; AD-625028) CFSTI: HC $1.00/MF $0.50

Ternary borides with the structure of cubic chromium carbide $Cr_{23}C_6$ were studied for their composition and atomic

arrangement. They were found to be ordered, showed composition dependence on the group number, and had melting phases around 1200° C. Their hardness exceeded that of hardened steel. Work on nitrides with perovskite structure continued. An appendix contains annotated publications that resulted from above studies. G.G.

N66-16676# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Metallurgical Engineering.
EFFECT OF ELASTIC AND PLASTIC DEFORMATION ON THE MARTENSITE TRANSFORMATION IN 25% Ni MARAGING-ALLOY SINGLE CRYSTALS
J. D. Defilippi and H. W. Paxton (Ph.D. Thesis) 1 Nov. 1965 121 p refs
(Contract Nonr-760(14))
(AD-623844) CFSTI: HC $5.00/MF $1.00

The effect of the magnitude and temperature of elastic and plastic deformation prior to transformation on the burst transformation characteristics of a 25% Ni maraging alloy was determined systematically. Uniaxial tensile strain equal to or less than the Luders' strain caused an 8° to 12° C rise in the burst temperature, M_b, of single crystals of various orientations that were strained at 0° C, 20° C, 120° C, or 220° C prior to transformation. When the prior plastic strain exceeded the Luders' strain, a 2° to 3° C decrease in M_b was observed for each 0.1 increment of glide strain in excess of the Luders' strain, and the amount of transformation product formed at M_b was observed to decrease linearly with increasing plastic strain. In deformed single crystals the majority of the martensite plates formed along four (259) habit plane variants that grouped about a <110> direction that was 35.3 degrees from both the pole of the primary and the conjugate slip planes and 60 degrees from the primary slip direction. In single crystals transformed under an elastic compressive load, a decrease in M_b was observed. The thickness of the crystal increased if the elastic compressive stress was less than 3 Kg./sq mm. and decreased if the stress was greater than 3 Kg./sq mm. TAB

N66-16739*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
STUDY OF ADHESION AND COHESION IN VACUUM Final Report
P. M. Winslow and D. V. Mc Intyre 20 Aug. 1965 120 p refs
(Contract NAS8-11066)
(NASA-CR-70046; P65-94) CFSTI: HC $4.00/MF $0.75
CSCL 11F

This study was made to determine the temperature, time and conditions under which adhesion or cohesion of structural metals occurs in a vacuum. The objective was to provide spacecraft designers with engineering data to ensure separation of instrument capsules and other components from spacecraft in the space environment. These studies were conducted at an environmental pressure of 5×10^{-9} torr over a temperature range of 25°C to 500°C and at compressive stresses within the elastic limits of the materials. Surface finishes and cleanliness of the test specimens simulated those of spacecraft hardware. Static tests were made, and the adhesive forces were measured. The equipment was modified for conducting dynamic tests in which one of the test specimens was oscillated ±2 degrees at 3 cps against the other (stationary) test specimen while under compressive load. Tests made with eleven material combinations established conditions of adhesion and cohesion. Author

N66-16852 Republic Steel Corp., Warren, Ohio.
SPECIFYING MAGNET STEELS
Arthur Marcantonio *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 287-296 refs (See N66-16826 07-23) CFSTI: $8.50

Actual production samples of low carbon flat rolled steels were magnetically evaluated for high density properties. Coercive force from 18 KG and permeability at 20 KG were the criteria of evaluation. Variables studied include: types of steel—(1) rimming steels, (2) aluminum stabilized steels, and (3) silicon stabilized steels; processing variables—(1) hot rolled temper rolled condition, (2) hot rolled, pickled, annealed condition, (3) critically stressed and annealed to produce larger grains, and (4) decarburized in addition to special processing designed to produce large grains. Author

N66-16853 Western Electric Co., Inc., Chicago, Ill.
TESTING STEELS FOR GRADIENT MAGNETS
Paul F. Elarde *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 297-304 refs (See N66-16826 07-23) CFSTI: $8.50

An electronic hysteresigraph combined with a Babbitt permeameter was used to determine the magnetic properties of steels for use in gradient magnets. With this equipment a complete hysteresis loop is automatically recorded to scale directly on graph paper in approximately one minute. Two separate loops were drawn for each sample. The H scale of one loop was set at 100 oersteds per inch for finding permeability at high inductions (20000 gauss). That of the second loop was set at 5 oersteds per inch for finding coercive force from an induction of 18000 gauss. Each loop was set to a B scale of 4000 gauss per inch (200 gauss per 1/20 inch). A summary of magnetic materials testing, a brief history relating to the development of hysteresigraphs, particularly the integrator portion, and a short description of the present hysteresigraph are included. Author

N66-16958# IIT Research Inst., Chicago, Ill.
DEVELOPMENT OF OXIDATION-RESISTANT HAFNIUM ALLOYS Bimonthly Report No. 3
Ray J. Van Thyne 15 Sep. 1965 15 p
(Contract NOw-65-0301-f)
(IITRI-B6040-3)

Oxidation resistance and mechanical properties are being investigated in connection with the development of hafnium alloys for use as uncoated structural materials in the temperature range between 2200° and 3000° F. Investigations of both binary and ternary alloy compositions indicate that vanadium, nickel, and silicon reduce oxidation resistance while chromium, aluminum and boron improve oxidation resistance. Hardness of the alloy decreases throughout the subscale and generally continues to decrease through the oxygen-affected alloy substrate. Hardness of the substrate just below the subscale is reduced by increasing Nb or Ta content in binary alloys. It is shown that two simple binary alloys of hafnium do not possess useful strength at 2500°F, which is well above the recrystallization temperature. Upon exposure to air, the alloys are significantly strengthened but the room temperature ductility is degraded. M.W.R.

N66-17032# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
STUDY OF THE EFFECT OF SOLIDIFICATION STRUCTURES ON THE STRENGTH OF METALS Quarterly Progress Report
R. Wayne Kraft and R. W. Hertzberg 30 Nov. 1965 6 p
(Contract DA-36-038-AMC-2723(A))
(QPR-2; AD-624772) CFSTI: HC $1.00/MF $0.50

Progress is reported on a study of the mechanical working of controlled eutectics and an exploratory program on the mechanical properties of light-metal controlled-eutectic alloys. Data obtained shows that ingots of the Al_3Ni-Al eutectic (with an imperfect fiber reinforcement, i.e., a colony structure) can be drawn and hydrostatically extruded. In the other area of research progress has consisted of the production of the first heats of three magnesium base eutectic alloys. Metallographic examination and other data give evidence that it will be possible to form the desired anisotropic structure in these alloys. TAB

N66-17087*# IIT Research Inst., Chicago, Ill.
GRAPHITE–METAL COMPOSITES Quarterly Report No. 2
Y. Harada and G. A. Rubin 21 Jan. 1966 32 p refs
(Contract NASr-65(09))
(NASA-CR-70320; IITRI-G6003-2) CFSTI: HC $2.00/MF $0.50
CSCL 11D

Compositional studies were made to determine the effect of graphite source material on the properties of Mo–C composites. Investigations of other systems incorporating tungsten, vanadium, hafnium, tantalum, niobium, and zirconium as the metal constituent were also conducted. Studies of time–temperature relationships in processing were initiated, and measurements of electrical resistivity were made. Among the conclusions are that the use of flat, platy particles as opposed to spherical cokes yield better bonding in graphite–metal composites. In the Nb–C system, room temperature flexural strengths of greater than 20 000 psi and an increase in strength at 2000°C can be expected for compositions in the eutectic range. Work with the zirconium system shows that room temperature strengths in excess of 13 000 psi can be realized at 50 wt% Zr. The processing temperature should not exceed the carbide–carbon eutectic temperature by more than about 50° C if significant loss of metal is to be avoided. C.T.C.

N66-17119# Naval Civil Engineering Lab., Port Hueneme, Calif.
POTENTIOSTATIC CORROSION STUDIES OF IRON, TYPE-304 AND TYPE-321 STAINLESS STEEL Technical Report, Jun. 1964–May 1965
Howard A. Porte Dec. 1965 40 p refs
(R423; AD-624269) CFSTI: HC $2.00/MF $0.50

Important in the control and prevention of corrosion, electrochemical characteristics of iron and two types of stainless steel in various electrolyte systems were investigated as part of a long-range study of the mechanisms of the electrochemical and physical transformations that occur at electrode-electrolyte interfaces. The anodic potentiostatic polarization of iron was investigated in deaerated 1N sulfuric acid, deaerated and aerated borate buffer solution (pH 8.4), and in deaerated and aerated seawater. The effects of potential rate change and chloride ion concentration on polarization characteristics were studied in the borate buffer and sulfuric acid solutions. Polarization curves were determined for Type-321 stainless steel in deaerated 1N sulfuric acid and in deaerated borate buffer; the effect of chloride ion concentration was studied in both solutions. Polarization experiments were performed on Type-304 stainless steel in deaerated 1N sulfuric acid; the effect of cathodic pretreatment was studied. Electrochemical polarization curves have proved to be useful in predicting which of a group of alloys would be the most corrosion resistant in a particular environment. Author (TAB)

N66-17165# Canada. Dept. of Mines and Tech. Surveys, Ottawa. Ferrous Metals Section.
THE STATUS OF THE HYDROGEN PROBLEM IN STEEL
R. D. Mc Donald Jul. 1965 21 p refs
(TB-72) Available from Queen's Printer, Ottawa: $0.50

Hydrogen problems in steel are described, with particular emphasis on the problem of embrittlement of ultra-high strength steels as manifested by delayed failure. Ways are described in which hydrogen enters steel and is recognized by tests. Theories that have been developed over the years of research are related and explained briefly in order of sequence up to the most recent proposals advanced. These theories serve to explain many of the observations concerning hydrogen. Alleviation of embrittlement still depends heavily upon diffusion treatments at baking temperatures, although many ways of preventing entry of hydrogen are being tried with moderate success. Author

N66-17166# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
EFFECTS OF LIQUID QUENCHING ON THE CONSTITUTION AND STRUCTURE OF SILVER-SILICON AND GOLD-SILICON ALLOYS
H. L. Luo, W. Klement, Jr., and T. R. Anantharaman Jul. 1965 16 p refs *Its* AEC Res. and Develop. Rept.-37
(Contract AT(04-3)-221)
(CALT-221-12) CFSTI: HC $1.00/MF $0.50

Rapid quenching from the liquid state is shown to lead to amorphous solidification of gold–silicon alloys around the eutectic composition and to the formation of three silver–silicon and gold–silicon intermediate phases. The β Ag–Si phase is hexagonal close-packed and may be considered a Hume-Rothery phase. The β and γ Au–Si phases have complex face-center cubic structures and may be looked upon as superlattices built of 8 and 125 unit cells, respectively, of the simple face-centered cubic structure of gold. The construction of the liquid-quenched alloys in both binary systems is discussed with reference to the rate of cooling from the melt. Author (NSA)

N66-17177# Battelle-Northwest, Richland, Wash. Metallurgical Research Section.
HIGH TEMPERATURE CORROSION OF CANDIDATE ATR STRUCTURAL MATERIALS
L. A. Charlot and R. E. Westerman Sep. 1965 71 p refs
(Contract AT(45-1)-1830)
(BNWL-100) CFSTI: HC $3.00/MF $0.75

The behavior of Hastelloy X-280 and Haynes Alloy 25 in static atmospheres of oxygen, methane, carbon monoxide, carbon dioxide, nitrogen, flowing helium, and water vapor at temperatures of 1120 and 1200° C was studied. Evaporation rates of the alloys and corrosion of weldments in contaminated helium were also studied. At 1200° C, Hastelloy X-280 and Inconel 600 demonstrate an oxidation resistance which would permit their use in oxidizing atmospheres for short periods of time, e.g., a few hours in air, with only moderate attack. Haynes Alloy 25 cannot be exposed to atmospheres containing a higher oxygen partial pressure than about 0.3 torr at 1200° C, even for short times, without risk of catastrophic attack. Haynes Alloy 25, Hastelloy X-280, and Inconel 600 evaporate at similar rates at 1200° C under vacuum conditions (pressures $\sim 10^{-4}$ torr). It appears that oxidation rates of the superalloys tested would not be too severe at 1200° C if the partial pressure of oxygen did not exceed a pressure of about 0.1 torr. Haynes Alloy 25 exhibited much greater stability in oxygen atmospheres at 1120° C than 1200° C. The relative rate of attack

by oxygen is comparable to the attack on Hastelloy X-280. At 1000° C, the oxidation resistance of Hastelloy X-280, Haynes Alloy 25, and Hastelloy C are similar in atmospheres of 3 torr oxygen pressure or greater. In general, however, Hastelloy X-280 seems to be more resistant to internal attack than Haynes Alloy 25 and also shows less dependence on surface preparation than either Haynes Alloy 25 or Hastelloy C. All oxidized alloys tended to spall when cooled from the test temperatures, even in the case of rather thin films. Haynes Alloy 25 was especially susceptible to oxide spallation, particularly when the sample was thermally cycled. Hastelloy X-280 was more stable during thermal cycling, although in both cases more more weight was lost from the sample by spalling than gained by oxidation. If Haynes Alloy 25 is to be used as a structural material in the ATR gas loop, cobalt bearing oxide particles can be expected to move within the coolant stream. Other gaseous contaminants such as methane, carbon dioxide, carbon monoxide, and water vapor can be harmful if their concentration reaches a high enough level. At 1200° C, 100 torr nitrogen pressure has no effect on Hastelloy X-280 and Haynes Alloy 25 except to inhibit evaporation. In the case of a system free of oxidizing contaminants, metal vapors from potential evaporating structural materials will be present in the helium gas, especially at temperatures in excess of 2000° F. The metal vapors must then be considered as potentially harmful as the expected gaseous contaminants in their deleterious effects on refractory metal irradiation specimens (solution and subsequent masking of irradiation effects). In the case of Hastelloy X-280–Haynes Alloy 25 weldments at 1200° C, the oxidation resistance of the Haynes Alloy 25 will determine the oxidation resistance of the couple. Hastelloy X-280–Hastelloy X-280 weldments show oxidation resistance equivalent to the parent metal. Grade A helium has a corrosive effect on Haynes Alloy 25 and Hastelloy X-280 at 1038° C. Hastelloy X- 280 forms a more tenacious scale and exhibits less internal attack for a given exposure. The superalloys tested exhibit extremely complex corrosion behavior as a function of oxygen pressure. At very low oxidant partial pressures (expected in the ATR loop), it is impossible to predict exactly what degradation phenomenon will be most important especially when the effects of high velocity, high pressure helium are not known. It is of utmost importance that a careful ATR structural material surveillance program be maintained. NSA

N66-17179# IIT Research Inst., Chicago, Ill. Technology Center.
YIELD PHENOMENA AND FRACTURE OF HYDRIDED ZIRCONIUM Quarterly Report, 1 Jan.–31 Mar. 1965
D. Weinstein 30 Apr. 1965 22 p refs
(Contract AT(11-1)-578)
(IITRI-B6035-7; EURAEC-1395; COO-578-P27-7) CFSTI: HC $1.00/MF $0.50

A program is in progress for the study of discontinuous yield phenomena in polycrystalline zirconium. It was suggested that yield point occurrence might be explained in terms of current models for discontinuous yield in body-centered cubic crystals, and data are being obtained which could lend evidence toward showing this relationship. Thus far, yield point occurrence in high-purity polycrystalline zirconium appears to be strongly dependent on average grain size. An explanation for this behavior under the current concepts for yield in body-centered cubic crystals was presented, but additional data are necessary. Author (NSA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N66-16229# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
CARBORANE-SILOXANE ELASTOMERS Quarterly Progress Report, 19 Aug.–18 Nov. 1965
Joseph Green [1965] 16 p refs
(Contract DA-11-070-AMC-852(W))
(RMD-5065-Q3; AD-624735) CFSTI: HC $1.00/MF $0.50

Polymers of structure—

$$(CH_3)_2Si(CH_2)_3CB_{10}H_{10}C(CH_2)_3Si(CH_3)_2(—OSi(CH_3)_2)$$

were found to be susceptible to thermal oxidation at about 240C. Materials of structure—

$$Si(CH_3)_2B_{10}H_{10}C(CH_2)_3—CB_{10}H_{10}CSi(CH_3)_2O$$

are expected to resist thermal oxidative attack due to the stabilization of silyl methyl groups by carborane. An investigation of the preparation of precursors having the structures—

$$HCB_{10}H_{10}C(CH_2)_3—CB_{10}H_{10}CH$$

was initiated and compounds with 3 and 4 methylene groups have been prepared. Author (TAB)

N66-16270 Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL MANUFACTURING OF PARABOLOID GLASS-PLASTIC COLLECTORS
E. B. Rubinov, G. Ya. Umarov, E. A. Pinkhasov, A. Ya. Bashnyak, and A. Abduazizov *In its* Heliotechnol. 3 Jan. 1966 p 19–23 refs (See N66-16266 07-34) CFSTI: $3.00

The feasibility of manufacturing a glass–plastic paraboloid collector with a reflecting surface obtained by direct vacuum condensation of aluminum vapors is shown. These are to be used for collecting solar energy flux. The methods of manufacture are given, subsequent testing is discussed, and problems associated with these processes are evaluated. Tabulations include relative temperature distribution in the collector focal spot and average coefficients of reflection under aluminum layer vaporizing conditions. C.T.C.

N66-16272 Joint Publications Research Service, Washington, D. C.
RAISING THE RESISTANCE OF POLYAMIDE FILMS TO LIGHT
G. A. Kleyn, A. N. Filippov, G. A. Adilkhodzhayeva, R. N. Alimova, and T. Sh. Khalmetova *In its* Heliotechnol. 3 Jan. 1966 p 27–30 refs (See N66-16266 07-34) CFSTI: $3.00

A study was made of the efficiency of polyamide film stabilization under the action of sunlight by treating this film with solutions of chromium and manganese salts. A method is given for treating these films with hot salt solutions, preventing the salts in the film from hydrolyzing, washing out, bleeding out of the film, etc. Also examined are changes in the physico-mechanical properties and the structure of the most widely used PK-4 polyamide films. C.T.C.

N66-16277 Joint Publications Research Service, Washington, D. C.
COEFFICIENT OF REFRACTION OF POLYETHYLENE TEREPHTHALATE FILM
N. V. Kordub *In its* Heliotechnol. 3 Jan. 1966 p 49–50 refs (See N66-16266 07-34) CFSTI: $3.00

The refraction coefficient of polyethylene terephthalate film is determined for use in the theoretical calculation of the shape of the surface of film concentrators. A film thickness of 13.5 microns was used in these experiments. The average value of the coefficient in the visible spectrum was found to be 1.75. It was also determined that as the radiation wavelength gets shorter the refraction coefficient rises uniformly from 1.71 (for wavelengths of 750 millimicrons) to 1.80 (for 400 millimicrons). M.R.W.

N66-16471*# Stanford Research Inst., Menlo Park, Calif.
STUDY OF GROWTH PARAMETERS FOR REFRACTORY CARBIDE SINGLE CRYSTALS Quarterly Status Report No. 7, Sep. 1–Dec. 1, 1965
R. W. Bartlett and W. E. Nelson 5 Jan. 1966 21 p *Its* Rept.-7 (Contract NASr-49(19))
(NASA-CR-69912) CFSTI: HC $1.00/MF $0.50 CSCL 11B

Results of crystal growth experiments utilizing two methods, the liquid metal solution growth of crystals and the a-c arc melting method for Verneuil crystal growth, are reported. The arc-Verneuil crystal growth experiments were directed primarily toward reducing carbon losses in the molten carbide by altering the gaseous environment. All of the boules grown in pure argon showed extensive carbon loss with the appearance of large quantities of Ta_2C and even in some cases tantalum metal. Photographs of typical argon-grown boules are shown, illustrating the structures observed. A number of experimental problems were encountered and operations were suspended to modify the power supply, the arc-Verneuil furnace was extensively redesigned. The solution growth experiments emphasized attempts to determine the tantalum solubility in several carbon-saturated liquid metals and crystal-pulling experiments using a cold probe or single crystal tantalum seed. In both cases, it was found that nucleation and growth of many small tantalum carbide crystals in the cool region of the melt cause a uniform dispersion of small tantalum carbide crystals and prevent both growth of a large single crystal and sampling of the liquid phase exclusive of solid tantalum carbide. M.R.W.

N66-16579# Forest Products Lab., Madison, Wis.
EDGEWISE COMPRESSIVE STRENGTH OF CORRUGATED FIBERBOARD AS DETERMINED BY LOCAL INSTABILITY Research Paper
R. C. Moody Dec. 1965 14 p refs
(FPL-46; AD-474386)

A method is presented for predicting the edgewise compressive strength of corrugated fiberboard. Local buckling was assumed to occur in the specimens and the edgewise compressive strength was calculated from critical buckling stresses for the components. B-flute corrugated fiberboard was found, both theoretically and experimentally, to be higher in edgewise compressive strength than either A- or C-flutes. Author (TAB)

N66-16585# Forest Products Lab., Madison, Wis.
COMPARISON OF TWO SPECIMEN SHAPES FOR SHORT COLUMN TEST OF CORRUGATED FIBERBOARD Research Note
J. W. Koning, Jr. Oct. 1965 15 p refs
(FPL-0109)

A comparative evaluation of short column test specimens of corrugated fiberboard indicated that the difference in average compressive strength was not significant between rectangular and necked-down shapes. Based on ease of specimen preparation, however, the rectangular specimen appears to be more practical for industry use than the necked-down shape. Author

N66-16588*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
FRICTION AND WEAR CHARACTERISTICS OF POLYIMIDE AND FILLED POLYIMIDE COMPOSITIONS IN VACUUM (10^{-10} mm Hg)
Donald H. Buckley Washington, NASA, Feb. 1966 13 p refs (NASA-TN-D-3261) CFSTI: HC $1.00/MF $0.50 CSCL 11D

The friction and wear characteristics of polyimide and filled polyimide compositions were examined in a vacuum environment (10^{-10} mm Hg). Copper-filled (to 50 weight percent) compositions as well as graphite- and molybdenum–disulfide-filled compositions were studied. Friction and wear experiments were conducted with a 3/16-inch-radius hemispherical rider sliding on a flat disk, which was rotated to produce sliding speeds to 1600 feet per minute. The polyimide was loaded against the disk (various metals) under a load of 1000 grams. The results of the investigation indicate that, to obtain effective lubrication (low friction and wear), a transfer of the polyimide film to the mating surface must be achieved. In its absence, high friction occurred with all polyimide materials. With copper addition, a minimum in wear rate was obtained at 30 weight percent copper. Both friction and wear increased with the addition of graphite as a filler to the polyimide. With the addition of molybdenum disulfide, marked decreases in both friction and wear occurred. Author

N66-16718# Picatinny Arsenal, Dover, N. J. Plastic Technical Evaluation Center.
ELECTRICAL PROPERTIES OF PLASTIC MATERIALS; DATA COMPILED FROM TECHNICAL CONFERENCE SEARCH
Arnold E. Molzon Jul. 1965 154 p refs
(PLASTEC-23; AD-624922) CFSTI: HC $5.00/MF $1.00

This report presents data on the electrical properties of plastic materials. It was compiled from the pertinent reports among the approximately 1600 papers which were presented at 49 technical conferences over the period from March 1960 to March 1965. Data is presented on: acrylate-ethylene copolymers; acrylics; alkyd; allylic; butadiene-styrene copolymer; diphenyl oxide; epoxy; ethylene-vinyl acetate copolymer; fluorocarbon; ionomer; melamine; phenolic; polyamide; polycarbonate; polyester; polyether; polyethylene; polyimide; polyphenylene oxide; polypropylene; polystyrene; polyurethane; silicone; urea formaldehyde; and the vinyls. Included are: a subject index, a list of company material designations, a list of references, the identification of the technical conferences from which the information was gathered, and a list of trade names which appear in (and are inseparable from the information presented in) this report. Author (TAB)

N66-16810# Joint Publications Research Service, Washington, D. C.
MICROCRYSTALLINE GLASS
Chia-Chih Li *In its* Transls. on Communist China's Sci. and Technol. 17 Jan. 1966 p 90–103 refs (See N66-16806 07-34) CFSTI: $6.00

Microcrystalline glass is obtained by adding an adequate amount of a crystal nucleating agent to the components of glass with subsequent precipitation of homogeneous and minute crystals by heat treatment. This method transforms the

original structure and characteristics of glass and enables it to withstand high temperatures of over 1000°C as well as increases its strength. Photosensitive microcrystalline glass is obtained by illumination with ultraviolet rays or high energy lights during crystalline precipitation. The characteristics of glass, microcrystalline glass, and clinker ceramics are briefly compared and some applications of microcrystalline glass are discussed. G.G.

N66-16816# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PECULIARITIES OF CREATION OF HEAT-RESISTANT FRICTIONAL MATERIALS

G. A. Georgiyevskiy 18 Nov. 1965 30 p refs Transl. into ENGLISH from the book "Povysheniye Effektivnosti Tormoznykh Ustroystv. Svoystva Friktsionnykh Materialov" Moscow, Akad. Nauk, 1959 p93–109

(FTD-MT-64-483; AD-624760) CFSTI: HC $2.00/MF $0.50

Principles of creation of frictional materials for work at high temperatures and pressures reduce to the following: use the friction series and series of wear-resistance to make the selection of friction ingredients; with this the thermal conductions and the influence of ingredients on counterbody of the friction pair should be taken into account. The binder should be heat-resistant, should preserve good elastic properties at high temperatures, and also should possess the ability to form coke-like products with good mechanical properties. The binder should have high adhesional properties. The content of organic binding should be minimum; this favors application of ingredients with little developed active surface. Increase and stabilization of coefficient of friction can be attained by: (a) introduction of oxidizers, promoting a lowering of the formation of liquid products of destruction and retaining the reduction of reactors; (b) additional heat treatment of friction material at a temperature of 400–600 degrees without an oxidizing medium. Every recommendation should be carried out in such a manner as to ensure the creation of frictional layer as a result of the use of heat emitted during braking. Author (TAB)

N66-16969*# Stanford Research Inst., Menlo Park, Calif.

MECHANICAL PROPERTIES OF CROSSLINKED POLY-(METHYL METHACRYLATE) POLYMERS UNDER SPACE ENVIRONMENTAL CONDITIONS Final Report, Jun. 1, 1963–Jan. 30, 1966

J. E. Frederick, N. W. Tschoegl, and Thor L. Smith 30 Jan. 1966 104 p refs

(Contract NASr-49(13) SRI Proj. PRU-4520)

(NASA-CR-70201) CFSTI: HC $4.00/MF $0.75 CSCL 11J

Crosslinked poly-(methylmethacrylate) polymers were studied in vacuum up to about 245°C by the continuous and intermittent stress-relaxation method. At 225°C, the stress remained constant during periods exceeding 1000 minutes. The stress decayed exponentially at 245°C. In all instances, the continuously and intermittently determined stresses were identical and the degradation characteristics were not dependent on the type of crosslinking agent. Tensile stress-strain data were determined at a series of constant extension rates between about 125 and 185°C on crosslinked and uncrosslinked polymers. Because of a relatively tight entanglement network, 1-minute moduli between 135 and 165°C are insensitive to crosslinker concentration and are essentially identical with that for uncrosslinked PMMA. The time and temperature dependence of the large deformation and ultimate properties are considered, along with the effect of temperature and crosslink density on the nonlinear strain function. Author

N66-16988# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.

SiB POLYMER DEVELOPMENT Quarterly Report, 1 Aug.–31 Oct. 1965

H. A. Schroeder and O. G. Schaffling 23 Nov. 1965 28 p refs (Contract NObs-92143)

(QR-3; AD-624544) CFSTI: HC $2.00/MF $0.50

Further studies with the recently discovered 'off-ratio' SiB-2 rubber confirmed that it is possible to make a SiB elastomer with 1000 to 1200 pounds tensile strength, although this species leaves something to be desired in heat resistance. A particularly interesting SiB representative was included in our investigation since the last report. Chemically it is a phenyl stubstituted SiB-4 polymer which can be obtained not only in the usual rubbery form but also as a viscous stock. Vulcanizates from this latter material exhibit outstanding heat-aging resistance surpassing the performance of any rubber we have seen so far. In addition, it was found to be still flexible as −80° F, thus indicating a wide range of elasticity. The investigation of antioxidents such as ferric oxide, tungsten oxide and ferrocene was intensified. The two oxides, especially, impart noteworthy resistance to deterioration of the polymers at elevated temperatures. TAB

N66-17172# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

THE VARIATION WITH TEMPERATURE AND POROSITY, OF THE MODULI OF RUPTURE AND ELASTICITY OF "STANDARD" ISOSTATICALLY PRESSED AND SINTERED BERYLLIA

K. Veevers and W. B. Rotsey Apr. 1965 22 p refs (AAEC/TM-290)

Some properties of isostatically pressed and sintered UOX beryllia, fabricated to a grain size of $\leq 3\mu$ were measured. The modulus of rupture of material of density 2.86 to 2.90 g cm^{-3} was measured in four-point bending over the temperature range 20° C to 1000° C. The data could be represented by the equation: $\sigma_f = 33{,}000 - 7.46T$ psi. The total variance was 19.5 × 10^6 psi made up of a "within" batch variance, of 15.8 × 10^6 psi and a "between" batch variance of 3.7 × 10^6 psi. The modulus of rupture at 20° C was measured on material with a total porosity range of 4 to 35 percent; the data could be represented by the equation: $\sigma = \sigma_0 \exp(-2.44P)$ psi. The modulus of elasticity was measured in four-point bending on 97.5 percent dense material and the data could be represented by the equation: $E = (51.45 \times 10^6) + (1.264 \times 10^2 T) - (1.442 + 10^{-1}T^2) - (2.595 \times 10^{-3}T^3)$ psi. The modulus of elasticity was measured as a function of porosity in the range 2 to 36.4 percent; the data could be represented by the equation: $E = E_0(1-1.47P) \times 10^6$ psi. Author (NSA)

N66-17173# Bendix Corp., Kansas City, Mo. Materials Engineering.

THERMAL CHARACTERISTICS OF SOME RIGID URETHANE FOAMS

Clifford H. Smith [1965] 12 p refs Presented at the 150th Am. Chem. Soc. Natl. Meeting, Atlantic City, 7 Apr. 1965 Submitted for Publication

(Contract AT(29-1)-613)

(BDX-613-69; CONF-650902-1) CFSTI: HC $1.00/MF $0.50

Experimental studies were made of the thermal characteristics for three rigid urethane foam formulations, one based on toluene diisocyanate (TDI), one on polymethylene polyphenylisocyanate (PAPI), and one on a combination of the two (TDI-PAPI). The methods used include the measurement of compressive strength at high temperatures, thermogravimetric analysis, differential thermal analysis, heat aging, and nitrogen analysis. The results show that the TDI foam has

little compressive strength beyond 140° C and loses weight rapidly above 225° C, while the other two foams have adequate strength to higher temperatures (up to 235° C) and do not lose weight below 300° C. Some possible reasons for the good thermal stability of PAPI-based foams are discussed. NSA

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N66-16183*# Vanderbilt Univ., Nashville, Tenn.
[PREDICTOR–CORRECTOR PROCESS IN WHICH THE SELECTION OF AN OPTIMUM CORRECTOR IS MADE EACH STEP] Quarterly Technical Report, Oct.–Dec. 1965
James R. Wesson Nov. 1965 12 p refs Presented at the Am. Mathematical Soc. Meeting, 12 Nov. 1965
(Contract NAS8-2559)
(NASA-CR-69882) CFSTI: HC $1.00/MF $0.50 CSCL 12A

A predictor–corrector process, which appears to be applicable to the numerical solution of a wide variety of differential equations, is described in which a new and optimum corrector is selected at each step. Characteristic roots are examined for a one-parameter family of stable correctors, and the method is given for choosing the optimum corrector from the fifth-order family. Equations for the process are presented, and a comparison is made with other selection methods. Changing the corrector at each step is one way to automatically achieve a balance between numerical stability and truncation error; and this step change can be accomplished without additional functional evaluations and with a relatively small increase in computing time. M.W.R.

N66-16200# Naval Air Development Center, Johnsville, Pa.
A SHORT-CUT SOLUTION FOR THE KOLMUGOROV-SMIRNOV TEST
Robert M. Herrick 8 Nov. 1965 10 p refs
(NADC-MR-6504; AD-624524) CFSTI: HC $1.00/MF $0.50

A simple graphical solution for the Kolmogorov-Smirnov test is presented. The solution is applicable to (a) comparison of distributions based on large numbers of cases, (b) comparisons in which the number of cases in the two samples are equal on unequal, (c) comparison of a sample distribution with a theoretical distribution. Author (TAB)

N66-16213# RAND Corp., Santa Monica, Calif.
NOTES ON N-PERSON GAMES VII: CORES OF CONVEX GAMES
Lloyd S. Shapley Oct. 1965 31 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4571-PR; AD-624310) CFSTI: HC $2.00/MF $0.50

The core of an n-person game is the set of outcomes that cannot be blocked by any coalition of players. It is shown in this memorandum that the core of a convex game has an especially regular structure, and that it is closely related to two other solution concepts. Specifically, (1) the value solution is the center of gravity of the extreme points of the core; (2) the von Neumann Morgenstern stable set solution is unique and coincides with the core. Author (TAB)

N66-16223# Princeton Univ., N. J. Econometric Research Program.
TESTS TO DISCRIMINATE BETWEEN LINEAR AND RATIO MODELS
Stephen M. Goldfeld and Richard E. Quandt 28 May 1964 22 p refs
(Grants NSF GS-30; NSF G-24462; NSF GP-579)
(RM-65)

Two exact tests are presented for testing the hypothesis that a linear [ratio] model explains the relationship between variables as opposed to the alternative that the ratio [linear] specification is correct. The first test is parametric and uses the F-statistic. The second test is nonparametric and uses the number of peaks in the ordered sequence of unsigned residuals. In conclusion, the results of some experimental calculations of the powers of the tests are discussed. Author

N66-16318# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON A METHOD OF CALCULATING THE EIGENVALUES OF MATRICES
A. I. Povzner [1965] 10 p refs Transl. into ENGLISH from Vychisl. Mt. i Mat. Fiz. (USSR), v. 5, no. 5, 1965 p 903–907

Results are expounded of numerical computations of the eigenvectors and eigenvalues of generally non-symmetric matrices. Insofar as the author knows, the convergence is proved only locally. The rapidity of covergence has been investigated. Considerations expounded in detail at the end of the work and reducing briefly to the fact that upon utilization of iteration processes in a massive computation it is often advantageous to select (without paying attention to global convergence) a locally rapidly covergent process, to start with an arbitrary vector, and to take a new random initial vector and to compute all over again if a solution is not obtained after a given number of iterations, underlie, primarily, the selection of just this method for the massive computation. Author

N66-16484# Tokyo Astronomical Observatory (Japan).
A METHOD OF NUMERICAL SOLUTION OF INTEGRAL EQUATIONS WHOSE KERNELS HAVE ALMOST DIAGONAL FORMS
Naosuke Sekiguchi 1965 16 p refs *Its* Ann., 2d Ser., v. 9, no. 2 CFSTI: HC $1.00/MF $0.50

A method of numerical solution of Fredholm's integral equations of the second kind and homogeneous integral equations, whose kernels have almost diagonal form, was developed by the author. According to this method, solutions are approximated by quadratic polynomials in each interval. In special cases, the numerical calculations can be performed in very simplified way. The present paper is the mathematical supplement of the author's work, whose main part is published in the *"Publications of the Astronomical Society of Japan*, 17, 136, 1965" under the title "On the excitation and damping of the polar motion". Author

N66-16519# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND THE NUMERICAL INTEGRATION OF BOUNDARY-VALUE PROBLEMS FOR UNSTABLE LINEAR SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS
R. E. Bellman, H. H. Kagiwada, and R. E. Kalaba Oct. 1965 14 p refs
(Contract AF 49(638)-66-C-0001; Proj. RAND)
(RM-4800-PR; AD-624123) CFSTI: HC $1.00/MF $0.50

In such diverse areas as radiative transfer in planetary atmospheres and optimal guidance and control, two-point boundary-value problems for unstable systems arise, greatly complicating the numerical solution. An invariant imbedding technique is presented which is useful in overcoming these frequently encountered instabilities, and the results of some numerical experiments are presented. Author (TAB)

N66-16602*# Stanford Univ., Calif. Dept. of Statistics.
BOUNDS AND RATES OF CONVERGENCE FOR THE EXTENDED COMPOUND ESTIMATION PROBLEM IN THE SEQUENCE CASE Technical Report No. 81
Donald D. Swain 17 Jul. 1965 110 p refs Sponsored in Part by NASA
(Contract Nonr-225(53))
(NASA-CR-70147) CFSTI: HC $4.00/MF $0.75 CSCL 12A

Let $\underline{\theta} = (\theta_1, \theta_2, \ldots, \theta_i, \ldots) -\infty < \alpha \leq \theta_i \leq \beta < \infty$ $i = 1, 2, \ldots$. Let $\Psi = \{p_\theta(\cdot)\ \theta \epsilon [\alpha, \beta]\}$ be a family of probability density functions. X_1 is an observation from p_{θ_1} and $\psi_1(X_1)$ is an estimate of θ_1. X_2 is an independent observation from p_{θ_2} and $\psi_2(X_1, X_2)$ is an estimate of θ_2. In general X_i is an independent observation from p_{θ_i} and $\psi_i(\underline{X}_i)$ is an estimate of θ_i. The average risk of an estimating procedure $\underline{\psi} = (\psi_1, \psi_2, \ldots, \psi_i, \ldots)$ after n estimates is

$$\frac{1}{n}\sum_{i=1}^{n} E[\psi_i(\underline{X}_i) - \theta_i)^2].$$

A sequence of standards is obtained for evaluating a procedure $\underline{\psi}$ in terms of its average risk as $n \to \infty$. For many families of densities including the Poisson, negative binomial, binomial, normal, and gamma, bounds on the difference between the average risk and a suitable standard are obtained for particular estimating procedures. Rates at which these bounds approach zero are given. Author

N66-16607# Princeton Univ., N. J. Dept. of Graphics and Engineering Drawing
FOUR-DIMENSIONAL DESCRIPTIVE GEOMETRY PROBLEMS ON 3-D SPACES
C. Ernesto S. Lindgren (U.S. Steel Corp.) Mar. 1965 35 p refs
(TSS-4; AD-621288) CFSTI: HC $2.00/MF $0.50

The paper presents new solutions of five problems in four-dimensional descriptive geometry. These problems were briefly discussed in previous papers. The new solutions have already been used in papers preceding this one but were not fully examined. Author (TAB)

N66-16675# Wisconsin Univ., Madison. Army Mathematics Research Center.
LIMIT CYCLES AND ROTATED VECTOR FIELDS Technical Summary Report
W. A. Coppel Jul. 1965 14 p refs
(Contract DA-11-022-ORD-2059)
(MRC-583; AD-623766) CFSTI: HC $1.00/MF $0.50

The paper discusses conditions under which a two-dimensional autonomous system has at most one cycle. A previous result is improved by means of a suitable extension of the theory of rotated vector fields. Author (TAB)

N66-16678# California Univ., Berkeley. Operations Research Center.
PRIMAL-DUAL DECOMPOSITION PROGRAMMING
Earl J. Bell Aug. 1965 42 p refs
(Contracts Nonr-222(83); DA-31-124-ARO-D-331; Grant NSF GP-4593)
(ORC-65-23; AD-625365) CFSTI: HC $2.00/MF $0.50

A primal-dual method for solving linear programs with a block-angular matrix structure is presented which employs the Decomposition Principle of Dantzig and Wolfe, who first studied this structure. Preliminary results indicate that the proposed method is more efficient than the standard decomposition method which uses the two-phase simplex method to solve an equivalent 'extremal program' with a reduced basis size whose coefficients are generated through the solution of linear subprograms. By contrast, the proposed method employs a primal-dual method and the coefficients are generated through subprograms with nonlinear objectives. These subprograms involve the maximization of a quotient of two linear functions subject to linear constraints in nonegative variables. Such problems are known as linear-fractional, rational objective, or hyperbolic programs and can be solved as a variant of standard linear programming. Under the conditions imposed by the primal-dual method, special parametric techniques can be employed to take advantage of particular matrix structures, such as the transportation structure, exhibited by the subprograms. Author (TAB)

N66-16750# RAND Corp., Santa Monica, Calif.
A PERTURBATION THEORY FOR NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS
Stephen H. Davis Nov. 1965 29 p refs
(Contract AF 49(638)-66-C-0001)
(RM-4795-PR; AD-624808) CFSTI: HC $2.00/MF $0.50

A perturbation theory is discussed in nonlinear partial differential equations which enables one to obtain uniformly valid solutions for a class of time-dependent equations.
Author (TAB)

N66-16804# RAND Corp., Santa Monica, Calif.
A LIMIT THEOREM FOR SUBADDITIVE COLLECTIONS OF SEQUENCES
Ion Folkman Nov. 1965 14 p ref
(Contract AF49(638)-700; Proj. RAND)
(RM-4802-PR; AD-624807) CFSTI: HC $1.00/MF $0.50

Information is presented about the asymptotic behavior of collections of sequences related by a certain inequality. These results generalize a well-known theorem on the asymptotic behavior of a subadditive sequence. The results have applications to dynamic programming, where sequences satisfying our inequality arise in a natural way. Author (TAB)

N66-16814# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
ON SOME ASPECTS OF INTEGER LINEAR PROGRAMMING Technical Report No. 16
Romulo H. Gonzales-Zubieta June 1965 111 p refs
(Contract DA-31-124-ARO-D-209)
(AROD-968-4; AD-624553) CFSTI: HC $4.00/MF $0.75

A primal feasible (all-integer) integer linear programming algorithm has been developed and programmed, together with a related procedure for obtaining a first feasible solution. Once a feasible solution is found, the algorithm maintains feasibility at each stage, in contrast to other algorithms that have been programmed and are currently available. These other algorithms do not achieve feasibility until the optimal solution is reached. The primal feasible algorithm is based on a particular

way of applying the cutting planes previously developed by R. E. Gomory, and on a specific interpretation of their role. The finiteness of convergence has been established for two-dimensional problems but not for the general case; however, there appears to be at least computational convergence in a considerable fraction of the cases. In addition, a generalized Euclidean algorithm for finding the greatest common divisor for more than two numbers is defined. The solution of systems of linear diophantine equations is presented in terms of integer linear programming. Some geometric considerations that help to illuminate the workings of the algorithm, are examined. Author (TAB)

N66-16825# RAND Corp., Santa Monica, Calif.
VARIANCE REDUCTION TECHNIQUES
W. L. Maxwell 6 May 1965 18 p refs
(P-3139; AD-615167) CFSTI: HC $1.00/MF $0.50

A variance reduction technique is a procedure which is used in a sampling experiment to reduce the underlying variance of the sample estimates. Such techniques have been used for decades by workers in the social sciences. Kahn presented a catalog of techniques applicable to Monte Carlo sampling experiments. Yet seldom are these techniques employed in the simulation of stochastic processes. The intent is to present some of the most fruitful variance reduction techniques and to explore their applicability to sampling the simulation of a stochastic process. Author (TAB)

N66-16994# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
DESCENT ON THE BOUNDARY OF A SPHERE Mathematical Note No. 433
A. A. Goldstein (Wash. Univ.) Oct. 1965 8 p refs
(DI-82-0482; AD-624745) CFSTI: HC $1.00/MF $0.50

A method is proposed for the problem of minimizing or finding stationary values of a differentiable function f which is constrained to the boundary of the unit sphere in E_n. In the special case that $\Delta(f)$ does not vanish on the unit sphere itself, this is a problem in convex programming, because then the extremal must occur on the boundary of the sphere. In this case, the method of convex programming in a Hilbert space could be used. The general situation, which is not convex programming, is considered. The method of attack follows A. A. Goldstein, 'On Steepest Descent', Feb. 1965, Journal SIAM Control, Vol. 3, No. 1. Author (TAB)

N66-16999# Stanford Univ., Calif. Dept. of Statistics.
FIRST PASSAGE TIMES AND OTHER ANALYSIS OF CONTINUOUS PARAMETER MARKOV CHAINS
I. Mac Neill and H. Rubin 15 Nov. 1965 16 p refs
(Contract Nonr-225(52))
(TR-111; AD-624458) CFSTI: HC $1.00/MF $0.50

Two methods are discussed of computing first passage times for a finite state, continuous time parameter markov chain. One of the methods involves a system of differential equations and the other is the laplace transform technique. Other analyses involve the transition probability matrix and the steady state distribution. Several techniques for making computations are given and an example is worked. A problem is solved which was presented by one of the agencies served under the Joint Services Advisory Group Program. Author

N66-17019# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrical Engineering
EXPANSION OF A NONPERIODIC PROCESS x(t) INTO A FOURIER SERIES WITH UNCORRELATED COEFFICIENTS
A. Papoulis 15 Jan. 1964 9 p refs *Its* Memo.-68
(Grant AF-AFOSR-453-63)
(PIBMRI-1203-64; AD-624266) CFSTI: HC $1.00/MF $0.50

If a stationary non-periodic process x(t) is expanded into a Fourier series in an interval $|t| < T/2$, then the coefficients of the expansion are not orthogonal. In this note it is shown that x(t) can be approximated by a series whose coefficients are exactly orthogonal. Author

N66-17029# California Univ., Berkeley. Dept. of Mathematics.
COMMENTS ON DIFFERENTIABILITY OF SOLUTIONS OF BOUNDARY VALUE PROBLEMS
Robert D. Moyer Sep. 1965 122 p refs
(Contract Nonr-222(62))
(AD-624299) CFSTI: HC $4.00/MF $0.75

In this report, the problem of smoothness of solutions of boundary value problems is considered. It is shown that the smoothness problem is reducible to a study of certain spaces of generalized solutions of the homogeneous adjoint problem. These spaces are then studied in the case of symmetric positive systems. The results are then applied to boundary value problems for singular ordinary differential equations. In this case, explicit conditions are given which can be used to determine the degree of smoothness of solutions. Author (TAB)

N66-17035# Virginia Univ., Charlottesville. Dept. of Economics.
AN ALTERNATIVE INTERPRETATION OF THE PRIMAL-DUAL METHOD AND SOME RELATED PARAMETRIC METHODS
C. van de Panne and A. Whinston Aug. 1965 27 p refs
(Contract Nonr-4811(00))
(ONR-RM-1; AD-624499) CFSTI: HC $2.00/MF $0.50

The primal–dual method is interpreted as a parametric linear programming method. Some variants and related methods, such as Dantzig's self-dual parametric method and the linear programming variant of Houthakker's capacity method for quadratic programming are considered and compared. Author (TAB)

N66-17040# Stanford Univ., Calif. Computer Science Dept.
THE AUTOMATIC CONSTRUCTION OF COMPUTATIONAL ALGORITHMS
G. I. Marchuk 30 Sep. 1965 58 p ref Transl. into ENGLISH from Russian
(Contract Nonr-225(37))
(CS30; AD-624829) CFSTI: HC $3.00/MF $0.50

Several documents by Professor G. I. Marchuk are translated dealing with the automatic construction of computational algorithms for finding numerical solutions to a wide variety of problems, including linear equations, integral equations, ordinary differential equations (initial value and boundary-value), and partial differential equations (elliptic, parabolic and hyperbolic). Finite-difference equations are constructed systematically by the method of splitting, based on the replacement of operators by the sum of simpler operators (e.g. as in alternating-direction methods). Author (TAB)

N66-17070*# Northwestern Univ., Evanston, Ill.
ON SOME INEQUALITIES AND THEIR APPLICATION TO THE CAUCHY PROBLEM
Avner Friedman [1963] 14 p refs
(Grant NGR-14-007-021) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Derivations are given for two inequalities, and these are applied to the Cauchy problem for infinite systems. Consideration is given to proving the uniqueness and existence of the Cauchy problem, and it is pointed out that the Goursat problem can be handled along the same lines. Generalizations of the two derived inequalities are included. C.T.C.

N66-17074*# Stanford Univ., Calif. Dept. of Statistics.
R CHART CONTROL LIMITS BASED ON A SMALL NUMBER OF SUBGROUPS
Frederick S. Hillier 4 Oct. 1965 24 p refs *Its* Tech. Rept.-83
Sponsored by NASA
(Contract Nonr-225(53))
(NASA-CR-70310) CFSTI: HC $1.00/MF $0.50 CSCL 12A

A previously proposed method for setting statistically sound $\bar{X}$ chart control limits is adapted to the R chart. This chart for the range R being a valuable tool for controlling the variability of a production process. After evaluating the reliability of the conventional R chart control limits, a new method is presented for setting these limits so that they can be used reliably regardless of how few subgroups have been inspected. C.T.C.

N66-17091*# Pennsylvania State Univ., University Park.
ON THE NUMBER OF L^2 SOLUTIONS OF $-y'' + q(t)y = \lambda y$ WHERE q(t) IS COMPLEX VALUED
Allan Krall [1963] 9 p refs
(Grant NGR-39-009-041)
(NASA-CR-70329) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Consideration is given to the differential equation $-y'' + q(t)y = \lambda y$ on an interval with the right end at ∞. It was previously shown that when q(t) is real valued; under certain conditions the differential equation does not possess two linearly independent solutions, both square summable toward ∞ ($\int^{\infty}|y|^2\,dt<\infty$). Its negation, the existence of two square summable solutions, being the limit circle case. Circle cases are not quite so precise when $q(t)=q_1(t)+i\,q_2(t)$, where $q_1(t)$ and $q_2(t)$ are real valued and $q_2(t)\not\equiv 0$. This paper shows that when $q_2(t)\not\equiv 0$, if $q_1(t)$ satisfies the same conditions stated for q(t) when q(t) is real valued, the number of square summable solutions toward ∞ can still be restricted in the same way. Author

N66-17092*# Pennsylvania State Univ., University Park.
ON THE EIGENVALUES OF A SINGULAR NONSELF-ADJOINT DIFFERENTIAL OPERATOR OF SECOND ORDER
Allen M. Krall [1965] 10 p refs
(Grant NGR-39-009-041)
(NASA-CR-70330) CFSTI: HC $1.00/MF $0.50 CSCL 12A

The nonself-adjoint operator $ly=y''+q(x)y$, where $q(x)=q_1(x)+iq_2(x)$, $q_1(x)$, and $q_2(x)$ are real valued, $\lim_{x\to a} q_2(x)=\delta$, $\lim_{x\to b} q_2(x)=\gamma$, was previously considered over an interval (a,b). From l, a nonself-adjoint operator L was defined in $L^2(a,b)$. If r is an arbitrary point in (a,b), it was shown that when $\lambda=\mu+i\nu$, $\nu\neq\gamma$, $ly=\lambda y$ has a solution $\psi(x,\lambda)$ in $L^2(r,b)$, and when $\nu\neq\delta$, $ly=\lambda y$ has a solution $\eta(x,\lambda)$ in $L^2(a,r)$. It was shown that if λ is an eigenvalue of L the Wronskian of $\psi(x,\lambda)$ and $\eta(x,\lambda)$ is zero. This paper characterizes these eigenvalues, the zeros of $W[\psi,\eta]$. Author

N66-17105 Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
AN APPLICATION OF THE MONTE CARLO METHOD TO THE SOLUTION OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS
Eric K. Jaede Jul. 1964 53 p refs
(RM-238; AD-473378)

The processes by which the Monte Carlo method is utilized to solve elliptic partial differential equations are described in detail. Author (TAB)

N66-17212* National Aeronautics and Space Administration, Washington, D. C.
ON THE THEORY OF SEQUENCES
S. V. Makarov *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 206-207 ref (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

The probability distribution of a sequence of identical outcomes in a series of trials is determined. Given that k is the number of trials, m is the number of sequences of a defined length, and l is that length; it is proven that $M(k,l)=(k-l+3)/2^{l+2}$, where M(k,l) is the mathematical expectation of the number of sequences. D.T.

N66-17235*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HEXADECIMAL TO DECIMAL CONVERSION TABLES FOR HEXADECIMAL VALUES 0-3F,FFF: DECIMAL VALUES 0-262,143
Jesse L. Maury, Jr. Nov. 1965 368 p
(NASA-TM-X-55397; X-542-65-462) CFSTI: HC $7.00/MF $2.00 CSCL 12A

Conversion tables are presented for advanced orbital programming systems. D.T.

N66-17241*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECT OF ADDITIONAL OBSERVATIONS ON A PREVIOUS LEAST SQUARES ESTIMATE
Raymond V. Borchers Dec. 1965 17 p refs
(NASA-TM-X-55409; X-547-65-497) CFSTI: HC $1.00/MF $0.50 CSCL 12A

In many applications of the least squares method it may be desirable to compute the influence of additional observations on a previously determined least squares estimate of the regression parameters and their associated covariance matrix. A particular application is presented in which the parameters are assumed to be constants, although the method can be extended to dynamic systems. Matrix equations which provide for additional observations are derived for the method of weighted least squares with uncorrelated errors. These recursion formulas reduce to the ones presented by Gainer in the case where only a single observation is added. R.N.A.

N66-17245*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTRODUCTION TO MATRIX GENERALIZED INVERSES AND THEIR APPLICATIONS
Sheldon E. Newhouse Jan. 1966 57 p refs
(NASA-TM-X-55415; X-643-66-34) CFSTI: HC $3.00/MF $0.50 CSCL 12A

An elementary presentation is given of the applications and mathematical properties of general inverse matrices. A discussion of pseudo-inverse rectangular matrices is also included. Applications considered are the analysis and the minimization of systems of linear equations. D.T.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N66-16230# Joint Publications Research Service, Washington, D. C.

CALCULATION OF PROCESSES CAUSED BY THE INTRODUCTION OF ICE CRYSTALS INTO SUPERCOOLED SMALL-DROP CLOUDS

S. L. Lebedev 8 Dec. 1965 14 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 164, no. 4, 1 Oct. 1965 p 796–799

(JPRS-33211; TT-65-33786) CFSTI: $1.00

A system of equations is sought whose solution gives the specific humidities of the gas, liquid, and solid phases of water in and under a cloud as functions of spatial and temporal coordinates, either under natural conditions or after seeding. This system describes crystallization processes in a cloud containing crystals and supercooled water droplets leading to the falling of snow. In addition to equations for the humidities computations, a heat flux equation and equations for determining quantities of droplets and crystals per unit mass of air are included in the system. Computations are made under the following assumptions: (1) complete entrainment of water droplets by the air; (2) spherically shaped crystals; (3) particle coagulation only in the case of different phases; and (4) coefficient of droplet capture by crystals equal to unity. The further assumption is made that, outside the cloud, the quantity of water droplets is equal to the quantity of condensation nuclei. Finally, the system as derived reflects the dependence of the crystallization process in low level clouds on the entry of crystals into them either from upper clouds or from seeding.

D.T.

N66-16238# Joint Publications Research Service, Washington, D. C.

RECENT DEVELOPMENTS IN METEOROLOGY AND HYDROLOGY

19 Nov. 1965 59 p refs Transl. into ENGLISH Meteorol. i Gidrol. (Moscow), no. 8, 1965 p 26–37, 40–46, 54–55, 60–63, 68

(JPRS-32943; TT-65-33520) CFSTI: $3.00

CONTENTS:

1. EFFECTIVE DISTRIBUTION OF AEROLOGICAL STATIONS IN THE NORTHERN HEMISPHERE S. I. Gubanova p 1–12 refs (See N66-16239 07-20)

2. NEW COMPUTATION OF THE HEAT BALANCE OF THE EARTH-ATMOSPHERE SYSTEM K. Ya. Vinnikov p 13–23 refs (See N66-16240 07-13)

3. STATISTICAL ANALYSIS OF RESULTS OF TESTS OF METHODS FOR FORECASTING THUNDERSTORMS N. A. Bagrov p 24–34 refs (See N66-16241 07-20)

4. INTERNATIONAL HYDROLOGICAL SURVEY OF THE BALTIC SEA B. A. Filippov p 35–37 (See N66-16242 07-13)

5. LITERATURE ON METEOROLOGY AND HYDROLOGY FOR 1964 p 38–44 refs

6. SEVENTIETH BIRTHDAY OF ANATOLIY FEDOROVICH DYUBYUK W. M. Berezin p 45–47

7. FOREIGN NEWS ON METEOROLOGY AND HYDROLOGY PUBLISHED IN USSR p 48–49

N66-16239 Joint Publications Research Service, Washington, D. C.

EFFECTIVE DISTRIBUTION OF AEROLOGICAL STATIONS IN THE NORTHERN HEMISPHERE

S. I. Gubanova *In its* Recent Develop. in Meteorology and Hydrology 19 Nov. 1965 p 1–12 refs (See N66-16238 07-20) CFSTI: $3.00

The development and generalization of a method for calculating the distribution of meteorological stations are presented and the principal improvements of this method over previous methods are discussed. Criteria for placement of new stations and the distribution of stations are given.

E.E.B.

N66-16241 Joint Publications Research Service, Washington, D. C.

STATISTICAL ANALYSIS OF RESULTS OF TESTS OF METHODS FOR FORECASTING THUNDERSTORMS

N. A. Bagrov *In its* Recent Develop. in Meteorology and Hydrology 19 Nov. 1965 p 24–34 refs (See N66-16238 07-20) CFSTI: $3.00

An analysis is presented of the tests previously made of several methods for forecasting thunderstorms. The correlation coefficient and the index of reliability are discussed and formulae are given for the determination of these indices. Advantages and disadvantages of the several methods are also included.

E.E.B.

N66-16370# Joint Publications Research Service, Washington, D. C.

STUDIES IN METEOROLOGY AND HYDROLOGY (NO. 10, 1965)

9 Dec. 1965 102 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 10, 1965 p 3–28, 36–44, 50–54

(JPRS-33250; TT-65-33825) CFSTI: $3.00

CONTENTS:

1. VERTICAL OZONE DISTRIBUTION IN THE EARTH'S ATMOSPHERE R. D. Bozhkov p 1–13a refs (See N66-16371 07-13)

2. COORDINATE-DOPPLER METHOD OF WIND OBSERVATIONS AND SOME RESULTS OF INVESTIGATION OF WIND FIELD HETEROGENEITIES IN ATMOSPHERE A. G. Gorelik, V. V. Kostarev, and A. A. Chernikov p 14–26 refs (See N66-16372 07-13)

3. ALLOWANCE FOR THE CHARACTERISTICS OF THE TEMPERATURE-PRESSURE FIELD OF THE LOWER STRATOSPHERE IN COMPILING SEASONAL FORECASTS Z. L. Turketti p 27–38 refs (See N66-16373 07-20)

4. APPROXIMATE CRITERION FOR DETERMINING THE POSSIBILITY OF INDUCING ARTIFICIAL PRECIPITATION FROM CUMULUS CLOUDS IN THE UKRAINIAN SSR G. F. Prikhot'ko p 39–43 refs (See N66-16374 07-20)

5. ON THE TENDENCY OF MODERN CLIMATE FLUCTUATIONS I. Ye. Buchinskiy p 44–51 refs (See N66-16375 07-20)

6. DETERMINATION OF EVAPORATION FROM A LAND SURFACE L. I. Zubenok p 52–56 refs (See N66-16376 07-20)

7. SYSTEMATIC ERRORS IN PRECIPITATION MEASUREMENT L. R. Struzer, I. N. Nechayev, and E. G. Bogdanova p 57–66 refs (See N66-16377 07-20)

8. REVIEW OF THE BOOK "STATISTICAL HYDROMECHANICS, MECHANICS OF TURBULENCE" Ye. M. Dobryshman p 67–70

9. NEW SOVIET BOOKS ON METEOROLOGY P 71–73
10. OBITUARY OF A. P. GAL'TSOV (1909–1965) p 74–75
11. INTERNATIONAL SYMPOSIUM ON DYNAMICS OF LARGE-SCALE ATMOSPHERIC PROCESSES p 76–80
12. NOTES ON THE INTERNATIONAL HYDROLOGICAL DECADE p 81–82
13. TWELFTH VOYAGE OF THE "A. I. VOYEYKOV" (MAY–JUNE 1965) p 83–85
14. SOVIET MEETINGS AND CONFERENCES ON METEOROLOGY p 86–88
15. NEWS OF SOVIET OCEANOGRAPHIC WORK p 89–91
16. FOREIGN METEOROLOGICAL NEWS PUBLISHED IN THE SOVIET PRESS p 92–93

N66-16373 Joint Publications Research Service, Washington, D. C.

ALLOWANCE FOR THE CHARACTERISTICS OF THE TEMPERATURE-PRESSURE FIELD OF THE LOWER STRATOSPHERE IN COMPILING SEASONAL WEATHER FORECASTS

Z. L. Turketti *In its* Studies in Meteorology and Hydrol. (No. 10, 1965) 9 Dec. 1965 p 27–38 refs (See N66-16370 07-20) CFSTI: $3.00

Changes in the geopotential and temperature fields of the lower stratosphere during summer and autumn were used to forecast the general character of natural synoptic seasons in early winter and in winter. The characteristics of winters are given by monthly anomalies of mean air temperatures for an area to the south of 60°N of the USSR boundary. It was found that the structure of the H_{100} geopotential field in the summer months together with the character and time of transition from stratospheric summer heat in high latitudes, is a criterion for the prediction of the coming winter's temperature regime.

G.G.

N66-16374 Joint Publications Research Service, Washington, D. C.

APPROXIMATE CRITERION FOR DETERMINING THE POSSIBILITY OF INDUCING ARTIFICIAL PRECIPITATION FROM CUMULUS CLOUDS IN THE UKRAINIAN SSR

G. F. Prikhot'ko *In its* Studies in Meteorology and Hydrol. (No. 10, 1965) 9 Dec. 1965 p 39–43 refs (See N66-16370 07-20) CFSTI: $3.00

The possibility of inducing artificial precipitation from cumulus clouds depends on the air temperature at the seeding level of about 200 to 300 m below the top of the clouds, the thickness and the volume of the clouds, the volume of its supercooled parts, and other parameters. Analyses of 94 cloud seeding experiments determined the possible inducement of artificial precipitation in relationship to the air temperature at cloud seeding level and the cloud thickness. Data related to this complex criterion coincided well with computed values on the necessary cloud thickness at which the formation of raindrops takes place.

G.G.

N66-16375# Joint Publications Research Service, Washington, D. C.

ON THE TENDENCY OF MODERN CLIMATE FLUCTUATIONS

I. Ye Buchinskiy *In its* Studies in Meteorology and Hydrol. (No. 10, 1965) 9 Dec. 1965 p 44–51 refs (See N66-16370 07-20) CFSTI: $3.00

Analyses of the mean monthly temperature charts collected at Kiew during the last 40 years gave evidence of a positive climatic warming trend. The warmest 5 year period (1935 to 1939) was replaced by a very cold 5 year period (1940 to 1944) and subsequently followed by a steady overall warming trend. Some fluctuations to cooling were found during January, February, March, July, and August in the last 5 year span. Moving mean monthly values of precipitation curves for 20 year averages established a definite decrease in precipitation.

G.G.

N66-16376 Joint Publications Research Service, Washington, D. C.

DETERMINATION OF EVAPORATION FROM A LAND SURFACE

L. I. Zubenok *In its* Studies in Meteorology and Hydrol. (No. 10, 1965) 9 Dec. 1965 p 52–56 refs (See N66-16370 07-20) CFSTI: $3.00

Evaporation data computed from the monthly and annual sums of ground surface evaporation were compared to computations using data from soil operators and water balance equations. Data computed from the evaporators showed a mean monthly deviation of 15%; monthly values determined by the water balance method had a 12% deviation. These comparisons revealed acceptable agreement between computed and measured values.

G.G.

N66-16377 Joint Publications Research Service, Washington, D. C.

SYSTEMATIC ERRORS IN PRECIPITATION MEASUREMENT

L. R. Struzer, I. N. Nechayev, and E. G. Bogdanova *In its* Studies in Meteorology and Hydrol. (No. 10, 1965) 9 Dec. 1965 p 57–66 refs (See N66-16370 07-20) CFSTI: $3.00

Principal systematic errors in measurements of precipitation constitute: (1) losses of collected precipitation due to moistening of the containers; (2) losses due to evaporation from the precipitation receptacle; and (3) undercollection of precipitation due to distortion of the wind field over the measuring instrument. A hole rain gauge with a wind velocity measuring device at its level of installation was used to obtain quantitative estimates of precipitation under elimination of the wind error. Mixed precipitation in the temperature range from −1 to +2° C had a quantitative dependence curve wind error lower than the error curve for a temperature of 0° to −5° C.

G.G.

N66-16425# European Atomic Energy Community, Brussels (Belgium).

SIXTH METEOROLOGICAL ANNUAL REPORT [6° ANNUARIO METEOROLOGICO]

G. Bollini and C. Gandino 1965 91 p refs In ITALIAN; ENGLISH summary

(EUR-2554.i) CFSTI: HC $3.00/MF $0.75

The meteorological year 1964, with its very hot July, is described following the methods of the preceding Annual reports. After short description of instruments and observed atmospheric phenomena, many tables and graphics are reported. In the second part is described the correlation between the meteorological diurnal cycle and the gamma dose rate from radioargon.

Author

N66-16443# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
REVIEW OF LITERATURE IN METEOROLOGY AND CLIMATOLOGY [LITERATUUROVERZICHT METEOROLOGIE] KLIMATOLOGIE]
16 Oct. 1965 28 p In DUTCH, GERMAN, and ENGLISH *Its* Vol. 11, No. M-131 CFSTI: HC $2.00/MF $0.50

Abstracts are presented on radio astronomy, meteorological satellites, cloud and terrestrial albedo determinations from Tiros photography, precipitation, forecasting, weather, air contamination, storm detection, lightning discharge, hurricane seeding experiments, circulation, turbulence, atmospherics, and related meteorological subjects. E.E.B.

N66-16632# Air Force Cambridge Research Labs., Bedford, Mass.
A SYSTEM FOR THE DETERMINATION OF THE VERTICAL WIND PROFILE FROM AN AIRCRAFT
James F. Morrissey Sep. 1965 19 p *Its* Instrumentation Paper No. 79
(AFCRL-65-704; AD-625188) CFSTI: HC $1.00/MF $0.50

This paper defines a proposed system for obtaining a vertical profile of the winds beneath an aircraft. It would be a low-cost system that would not place any restrictions on the track of the aircraft. The paper also attempts to define some of the problem areas associated with development of the system and to demonstrate that these problems are not insurmountable. Author (TAB)

N66-16645# Weather Bureau, Washington, D. C.
STUDIES ON THE METEOROLOGY OF GREENLAND Interim Report, Sep. 15, 1963–Mar. 15, 1964
W. L. Schallert [1964] 38 p Sponsored by Army
(IR-4; AD-624505) CFSTI: HC $2.00/MF $0.50

Wind roses have been prepared for a group of stations on Greenland, and in the surrounding area, at six levels in the free atmosphere. The roses have been entered at the appropriate location on a map of the area to provide a concise areal display of the frequency distributions of the wind direction. Mean wind speeds from each compass direction are shown as well. Author (TAB)

N66-16660# Space Data Corp., Phoenix, Ariz.
DESIGN, DEVELOPMENT AND FLIGHT TEST RESULTS OF THE LOKI INSTRUMENTED DART SYSTEM Final Scientific Report, May 1964–Oct. 1965
Robert L. Walker Oct. 1965 73 p
(Contract AF 19(628)-4164)
(SDC-TM-92; AFCRL-65-844; AD-625481) CFSTI: HC $3.00/MF $0.75

The instrumented dart system is the upper stage of the Loki dart meteorological sounding vehicle designed to measure vertical profiles of temperature and winds between 200,000 feet and 75,000 feet altitude. The purpose of this effort was to design and flight test the complete instrumented dart compatible with the Loki type motor. The components of the instrumented dart include the dart assembly, time delay and expulsion system, telemetry system, temperature sensor, and parachute. The telemetry system was designed to be compatible with the Rawin set AN/GMD-1B and associated equipment such as the radiosonde receiver AN/TMQ-5C. Flight tests of the system were conducted at White Sands Missile Range, New Mexico and the Air Force Eastern Test Range, Cape Kennedy, Florida. Results from these tests demonstrated the feasibility of using a Loki dart type vehicle for measurement of upper atmosphere winds and temperatures. Author (TAB)

N66-16670# Texas A&M Research Foundation, College Station.
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESO-SCALE SYSTEMS Ninth Quarterly Progress Report, 1 May–31 Jul. 1965
Walter K. Henry, John F. Griffiths, and Sidney O. Barnard [1965] 103 p refs *Its* Ref.-65-31T
(Contract DA-36-039-SC-89202)
(Rept.-9; AD-623175) CFSTI: HC $4.00/MF $0.75

The coefficient of association is used as a tool to identify the meso-scale vs. the macro-scale rainfall. This tool is used across Central America and in smaller areas to determine the rainfall relationship. The areas of close relationship are small, indicating that the rainfall is from meso-scale systems along the North Coast of Honduras. A singularity in the data for October 1954 in Panama is investigated to determine its uniqueness, and its cause. An harmonic analysis of the monthly precipitation for all the long period stations in Central America has shown that an objective description of the pattern of the annual march of rainfall can be obtained. The resultant lines of equal phase angle and amplitude clearly show meso-scale rainfall regions. Author (TAB)

N66-16762# Travelers Research Center, Inc., Hartford, Conn.
SUMMARY OF SHORT-PERIOD TERMINAL WEATHER INFORMATION STUDIES Final Report, Jul. 1964–Sep. 1965
Keith D. Hage, Herbert D. Entrekin, and James W. Wilson Oct. 1965 71 p refs
(Contract FA-65-WA-1192)
(SRDS-RD-65-120)

Computer programs for converting data from punched paper tape to magnetic tape, and for decoding, error-checking, and summarizing the digital weather observations of the mesonet-work surrounding Atlantic City, N. J. were developed and tested. The objectives and scope of these programs are described and sample outputs are illustrated. Twenty-five summer season data samples from 5 to 8 mesonetwork stations were processed. Brief summaries are given of the results of additional investigations carried out under the present project. These investigations were studies of space and time variations in transmission along runways at John F. Kennedy International Airport, case studies of fog and low cloud in the Washington, D. C. Mesonetwork, and studies of radar forecasts of visual range in snow. Author

N66-16809# Joint Publications Research Service, Washington, D. C.
PROBLEM OF SINGLE WEATHER STATION TO REPORT LOCATION OF THUNDER LIGHTNING ACTITITIES
Chen-Ch'Ao Ku *In its* Transl. of Communist China's Sci. and Technol. 17 Jan. 1966 p 64–72 refs (See N66-16806 07-34) CFSTI: $6.00

The use of thunder-lightning electromagnetic waves to determine the position and characteristics of distant thunder lightning by a single weather station is studied. If the thunder lightning is regarded as the change in torque of even-numbered electric poles of the vertical direction, then approximately beyond a distance of 10 kilometers the electromagnetic wave can be considered as a plane wave and the change of the electric field can be calculated. This method uses the statistical characteristics of a certain frequency electric wave amplitude to determine distance with an accuracy of 10%. Outlined are also methods to use the variation of the amplitude distribution or the different transmitting velocities of electric waves at different frequencies to determine the distance. G.G.

N66-16970*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT FOG DROPS: INVESTIGATION OF WARM FOG PROPERTIES AND FOG MODIFICATION CONCEPTS Quarterly Progress Report, Period Ending 15 Feb. 1966
Warren C. Kocmond [1965] 26 p refs
(Contract NASr-156)
(NASA-CR-70202; CAL-RM-1788-P-11) CFSTI: HC $2.00/MF $0.50 CSCL 04B

In the investigation of natural fogs, measurements were made of drop size distributions, nuclei concentrations, and liquid water content. On the basis of the results, it is suggested: (1) that dense radiation fog could be prevented by the introduction of large, extremely hygroscopic nuclei into the atmosphere; and (2) that fog could be dispersed by electrically charging alternate adjacent regions of the fog with opposite polarities. D.T.

N66-16972# Israel Program for Scientific Translations, Ltd., Jerusalem.
LONG-RANGE HYDRODYNAMIC WEATHER FORECASTING
E. N. Blinova, ed. 1965 13 p refs Transl. into ENGLISH of the book "Gidrodinamicheskii Dolgosrochnyi Prognoz Pogody" Moscow, Izdatel'Stvo "Nauka", 1964
(TT-65-d0009) CFSTI: $4.00

Presented are articles on the following: *The Theory of Hydrodynamic Climate and Long-Range Weather Forecasting*; *Two-Level Forecasting Scheme for the Geopotential and Vertical Currents*; *Forecasting Zonal Circulation Using Covariances*; *On the Distribution of the Covariances of the Pressure Field at the Mean Level of the Atmosphere*; *Humidity Forecasting*; *Forecasting the Heights of the Isobaric Surfaces of the Mean Level of the Atmosphere Using the Real Profile of the Zonal Flow Velocity*; and *Long-Range Forecasting of the Zonal Circulation*. E.E.B.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N66-16182*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
OPTIMIZATION OF MIDCOURSE VELOCITY CORRECTIONS
Robert G. Stern and James E. Potter Nov. 1965 21 p refs Presented at the Symp. on Autom. Control in the Peaceful Uses of Space, Sponsored by the Intern. Federation of Autom. Control, Stavanger, Norway, 21 Jun. 1965
(Grant NsG-254-62)
(NASA-CR-69881; RE-17) CFSTI: HC $1.00/MF $0.50 CSCL 22C

A method described to determine the optimum time at which to apply a single midcourse velocity correction is particularly adaptable to variable-time-of-arrival guidance. By exploiting the critical-plane coordinate system, a single curve can be prepared prior to flight to give the optimum correction time as a function of a miss parameter determined from in-flight navigational measurements. A method is also presented for determining an optimum schedule for midcourse corrections, for which the sum of the magnitudes of all the corrections is minimized. Since there are only two constraints at the nominal time of arrival in position-constrained variable-time-of-arrival guidance, there can be a maximum of two corrections in the optimum schedule. The ranges of miss parameter in which these two corrections are preferable, along with times and components of the corrections are determined by a geometric model based on the theory of convex sets. In effect, the concept of a six-dimensional state space is used to develop the fundamental equations of linearized midcourse guidance. The control action taken is determined by the predicted miss vector. M.W.R.

N66-16311# Naval Oceanographic Office, Washington, D. C.
SECTOR RADIO-RANGE BEACONS [SEKTORNYYE RADIO-MAYAKI]
A. I. Mizernitskiy 1965 15 p Transl. into ENGLISH from Navigatsiya (Moscow), 1963 p 406-417
(TRANS-248; AD-624201) CFSTI: HC $1.00/MF $0.50

The structure, types and operation of the sector radio-range beacons are described and illustrated by diagrams. The switching of phases in inner and outer antennas and their significance in determining the location of ships is analysed. The operating method of the radio-range beacon Terpeniya is presented as an example. Data on call letters, Kc, base length, transmission signals, direction of normal, etc., are tabulated for the beacons at Bushmills, Stavanger, Ploneis, Seville, Rybachiy, Kanin, Terpeniya and Shumusku. Author (TAB)

N66-16317# Burroughs Corp., Paoli, Pa. Control Instrument Div.
GUIDE-LITE HELIPORT SYSTEM Final Report
Eugene T. Hain Dec. 1965 46 p refs
(Contract FAA-WA-4534)
(SRDS-RD-65-57)

A detailed description is given of the design and construction of a ground-based visual landing aid for helicopters. The purpose of the device is to identify the landing site and indicate the proper landing path and approach velocity. The unit is operational and will be flight tested and evaluated by the FAA. Author

N66-16524# Federal Aviation Agency, Atlantic City, N. J. Experimentation Div.
FEASIBILITY STUDY OF AIRBORNE TACAN INTERROGATOR MODIFICATIONS TO REDUCE FALSE SECTOR LOCK-ON Final Report
Bernard Weinstein, John Walls, Carl Trout, and Henry Hurley (FAA, Washington, D. C.) Jul. 1965 18 p
(RD-65-82; AD-618415) CFSTI: HC $1.00/MF $0.50

A feasibility study of airborne TACAN interrogator modifications to reduce false sector lock-ons has been conducted. Two different types of circuit modifications were investigated: In one type, called Modification No. 1, the 15-cps gate-width was limited to a maximum of ±10 degrees. This allowed the 15-cps error to be as much as ±10 degrees without causing any error to be indicated on the Course Deviation Indicator (CDI). In Modification No. 2, the 15-cps gate-width was limited to a maximum of ±20 degrees. This allowed the 15-cps error to be as much as ±20 degrees without causing the servo motor to go into the search condition. TAB

N66-16570# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
STUDY OF BASIC REQUIREMENTS FOR A NAVIGATION, GUIDANCE, AND CONTROL SYSTEM FOR AN UNMANNED LUNAR LANDING VEHICLE Final Summary Report
E. J. Bowers, R. L. Taylor, E. H. Thompson, and J. W. Knight Huntsville, Ala., NASA. Marshall Space Flight Center, Dec. 1965 329 p refs
(Contract NAS8-11254)
(NASA-CR-61118) CFSTI: HC $7.00/MF $1.75 CSCL 17G

This document is a final summary report for a study to establish basic sensor requirements for a spaceborne navigation, guidance, and control system capable of performing unmanned lunar landings from a point in the earth-lunar midcourse trajectory to touchdown on the lunar surface. A determination of candidate systems and an exposition of possible tradeoffs is performed and, based on these results, a recommended system is derived. Sensor requirements, in the main, are found to be well within the state-of-the-art, the most severe requirement being that on measurement of vehicle-beacon line-of-sight rate during the main braking phase. Author

N66-16644# Gorham Corp., Waltham, Mass. Pickard and Burns Electronics Div.
OMEGA—A WORLD-WIDE NAVIGATIONAL SYSTEM. SYSTEM SPECIFICATION AND IMPLEMENTATION
J. A. Pierce (Harvard Univ.), W. Palmer (Sperry Gyroscope Co.), A. D. Watt (Deco Electron., Inc.), and R. H. Woodward 1 Jun. 1964 268 p refs
(Contracts Nonr-1866(07); Nonr-4173(00); Nonr-4107(00); Nonr-4105(00))
(P&B-886; AD-603764) CFSTI: HC $7.00/MF $1.75

This report presents a design plan for a radio-locating facility providing world-wide position fixing of moderate (one-mile) accuracy by phase comparison of VLF (10–14 kc) continuous wave radio signals from only eight strategically located transmitting stations usable by aircraft, ships, and land vehicles, and by submarines at moderate (40–50 feet) antenna depths. TAB

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N66-16237# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum.
COATING OF NUCLEAR FUEL PARTICLES WITH PYROLYTIC CARBON [BESCHICHTUNG VON KERNBRENNSTOFFPARTIKELN MIT PYROLYTISCHEM KOHLENSTOFF]
P. Koss, O. Kofler, H. Märkl, and K. Wallisch [1965] 31 p refs In GERMAN
(SGAE-M-3/1965) CFSTI: HC $2.00/MF $0.50

Described are two sintering furnaces for pyrolytic coating of nuclear fuel particles through reaction with methane. The first installation uses a centrally cooled vent to introduce the gas into the vibrating coating chamber and has a coating capacity of up to 50 g UC_2 grains. Physical and mechanical characteristics of the coating layers depend primarily on the crystal size of the pyrolytic carbon, its structural orientation, and its density. A strong temperature-time relationship for coating depositions was observed; increased methane injection accelerated coating depositions. The second sintering apparatus utilizes a porous bottom plate to introduce the coating gas. Cooling of the plates prevents their pores from clogging up, and yields of 80% to 90% methane absorbtion are obtained at 1800° C reaction temperature. Transl. by G.G.

N66-16282*# Columbia Univ., New York. Plasma Lab.
U-235 RESONANCE CROSS SECTIONS AND GASEOUS CORE REACTOR CALCULATIONS
Gunter W. Tumm Aug. 1965 116 p refs Sponsored by NASA *Its* Rept.-22
(Contracts AF 49(638)-1254; AF 49(638)-1634)
(NASA-CR-69827) CFSTI: HC $4.00/MF $0.75 CSCL 18I

A set of resonance cross sections were calculated for an almost completely thermal U-235 gaseous core reactor system. The cross sections compare well with measured results both with respect to the effective resonance integrals and also when applied to recalculation of the measured critical masses. Doppler temperature coefficients resulting from the new resonance data are shown to be of significant importance in the low temperature range between 300° K and 2320° K; and must be taken into account for more accurate critical mass calculations. L.S.

N66-16305*# Oak Ridge National Lab., Tenn.
SNAP-8 CORROSION PROGRAM Summary Report
W. R. Huntley et al Dec. 1965 223 p refs
(NASA Order C-220-A; Contract W-7405-ENG-26)
(NASA-CR-69822; ORNL-3898) CFSTI: HC $6.00/MF $1.25 CSCL 18N

To investigate the compatibility of the structural materials and NaK coolant in the SNAP-8 primary coolant circuit, a corrosion loop program was undertaken which used reduced-scale forced-flow loops that closely simulated the actual system. Loop design was primarily a chromized Hastelloy N heated section and Croloy 9M heat exchanger section connected by stainless steel. Eleven loop experiments were completed which accumulated about 25 000 hr of operation at design conditions. In addition to an oxide break, plugging-indicator breaks were observed at 800 to 1100° F and 400 to 600° F; the first is believed to be due to argon and the precipitate in the second was not identified. A third plugging curve break was consistent with the cold-trap operating temperature and represented the design oxide level. Control of oxygen level varied with loop conditions. Studies indicate that loop exposures cause development of carbide and sigma phases. Additions of hydrogen to the NaK produce no detrimental effects, and the addition of 1 to 4 atm % lithium considerably diminishes the hydrogen activity. M.W.R.

N66-16406# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON NUCLEAR AND REACTOR TECHNOLOGY [LITERATUUROVERZICHT, ATOOMKERNTECHNIEK EN REACTORKUNDE]
Sep. 1965 28 p refs In DUTCH, ENGLISH, FRENCH, and GERMAN *Its* Vol. 7, no. R-78 CFSTI: HC $2.00/MF $0.50

Abstracts of reports relating to nuclear and reactor technology are presented. Work is reported for turbo-machinery for high temperature gas-cooled reactors; moderator materials; projection effects on heat transfer and pressure losses in channel flow; special fabrication techniques for cladding and structural materials; reactor instrumentation; and nuclear fuel

element pellet sintering. Also reported are a filter pack technique for the classification of radioactive aerosol by particle size; thermoluminescent and radiophotoluminescent methods for dosimetry; optical properties of titanium dioxide as a reflector for plastic scintillators; and electron-bombardment damage in silicon solar cells. Nuclear safety; radon concentration in air; and technical news are also discussed. L.S.

N66-16435# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).
RESULTS WITH A MULTIPURPOSE ISOTOPE SEPARATOR [ERGEBNISSE MIT EINEM MEHRZWECKISOTOPENTRENNER]
F. P. Viehbock [1965] 32 p refs In GERMAN Submitted for Publication
(SGAE-PH-30/1965) CFSTI: HC $2.00/MF $0.50

Design and application of the Seibersdorf multipurpose electromagnetic isotope separator are discussed. This apparatus uses ionic beams of 10^{-14} to 10^{-10} A for mass spectrometric measurements of irradiated nuclear fuels, and ionic beams of 10^{-9} to 10^{-7} for the bombardment of solid targets. Separation of radioactive isotopes takes place at 10^{-6} to 10^{-4}A, and the separation of stable isotopes is performed by concentrated beams of 5 mA. A table presents results of a mass spectrometric analysis of an ytterbium separation.
Transl. by G.G.

N66-16436# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seiberdorf (Austria). Reaktorzentrum.
EXPERIMENTS ON THE RECLAMATION OF GRAPHITE–CARBIDE ELEMENTS OF HIGH-TEMPERATURE REACTORS [UNTERSUCHUNGEN ZUR WIEDERAUFBEREITUNG DER GRAPHIT–KARBID-BRENNSTOFFEINSATZE VON HOCH TEMPERATURREAKTOREN]
H. Bildstein, K. Knotik, G. Stolba, and H. Wagner Oct. 1965 30 p refs *In* GERMAN Submitted for Publication
(SGAE-CH-22/1965) CFSTI: HC $2.00/MF $0.50

Various procedures for reprocessing high temperature carbide–graphite fuel elements are briefly reviewed, and a new method employing thermal shock of 2600° to 2800° to induce fuel pellet disintegration is outlined. After the graphite coating of the fuel elements is cracked by this induction heat treatment, pellets are exposed to bromide vapor to free the nuclear fuel from its matrix. Subsequent chlorination at 1000° C, followed by condensation, extracts quantitative uranium. This head-on process is recommended for reprocessing in close vicinity of an reactor centrum and can be used with a number of different reactor fuels. G.G.

N66-16437# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seiberdorf (Austria). Reaktorzentrum.
THE REACTOR IRRADIATION OF TERPHENYL [DIE REAKTORRADIOLYSE VON TERPHENYLEN]
E. Proksch, F. Wiesinger, W. Szinovatz, and H. Eschweiler Oct. 1965 25 p refs In GERMAN Submitted for Publication
(SGAE-CH-23/1965) CFSTI: HC $1.00/MF $0.50

The radiolytic decomposition of an isomeric terphenyl mixture has been measured using two different positions of the pool-type reactor ASTRA (fast neutron dose fraction 50.4% and abt. 23%, resp.). The measured values have been used to evaluate by extrapolation the radiolytic action of both, pure gamma radiation and fast neutrons. For the temperature range of 275–350° C average values have been found as follows with initial G- values using first and second order kinetics, respectively: G_γ (⟶HB) = 0.158 or 0.151; G_n (⟶HB) = 0.278 or 0.333; G_γ (Gas) = 0.0139 or 0.0112; G_n (Gas) = 0.096 or 0.104. Accuracy and significance of these values is discussed. Furthermore, radiolytic gas compositions and the influence upon radiolysis of oxygen present have been determined.
Author

N66-16525*# TRW Systems, Redondo Beach, Calif.
FEASIBILITY STUDY OF DIRECT FLOW GAS CORE REACTOR SYSTEM
Henry M. Hunter and P. Degarabedian 31 Jan. 1966 316 p refs
(Contract NASw-1166)
(NASA-CR-70013; STL-4393-6003-RO-000) CFSTI: HC $7.00/MF $1.75 CSCL 18I

The purpose is to investigate the feasibility of a direct-flow gas-core propulsion reactor concept employing a single axial gaseous fuel jet surrounded by a coaxial stream of gaseous hydrogen propellant. The proposed concept avoids the problems of fuel retention associated with more complex flow fields by collecting the single fuel stream in a scoop located at the discharge end of the reactor where it is cooled, condensed to the liquid phase, and recirculated. The study is primarily concerned with the feasibility of the scoop that collects the hot gaseous fuel at the reactor discharge and, consequently, operates in a severe thermal environment. Computer programs were used to determine the heat loads and mixing between fuel and propellant streams. Various advanced cooling techniques were used to determine the feasibility of cooling the fuel scoop. The propulsion system was analyzed in sufficient depth to uncover critical problem areas and to establish reasonable design and performance conditions for evaluation of system feasibility.
Author

N66-16963*# National Aeronautics and Space Administration, Washington, D. C.
NUCLEAR ROCKETS BASED ON GRAPHITE REACTOR TECHNOLOGY—THEIR APPLICATIONS AND DEVELOPMENT STATUS
Harold B. Finger, Paul G. Johnson, John Morrissey, and Alan R. Siegel [1964] 129 p Presented at the 2d AGARD Lecture Ser. on Nuclear Propulsion, Brussels, 28 Sep. 1964 Prepared jointly with AEC
(NASA-TM-X-54858) CFSTI: HC $4.00/MF $1.00 CSCL 21F

A collection of lectures defines the United States' program to provide nuclear rockets for space exploration and describes the mission applications of such rockets. Vehicle applications are considered for rockets based on a graphite reactor technology; and performance, trajectory, payload, energy and initial-weight requirements, and thrust are discussed. Both manned lunar and unmanned solar system mission use of nuclear rockets is delineated. Performance, reliability, characteristics, and systems of the NERVA engine are detailed. A section on advanced research and technology discusses nuclear engine clustering, thrust requirements, Phoebus development and power, nozzle testing, feed systems, radiation effects, dynamic engine simulation, and the Plum Brook reactor.
M.W.R.

N66-17098*# Florida Univ., Gainesville. Dept. of Engineering Science and Mechanics.
RESEARCH INVESTIGATIONS OF BULKHEAD CYLINDRICAL JUNCTIONS EXPOSED TO COMBINED LOAD, CRYOGENIC TEMPERATURES AND PRESSURE. PART I: EXPERIMENTAL STUDIES
C. A. Sciammarella Nov. 1965 109 p refs
(Contract NAS8-5199)
(NASA-CR-70328) CFSTI: HC $4.00/MF $0.75 CSCL 20K

The objective of this study is the experimental analysis of one design version of an aft-bulkhead-connection ("Y-ring section") of a Saturn V S-IV lox container. Two different sections are contained in the report. The first section deals with a two-dimensional analog model built to study the bending stresses of the "Y-ring." Two experimental stress techniques were applied in this study. The Moire method was utilized to measure displacements. Photoelasticity was used to measure possible stress concentration effects. The second section of the report deals with the study of a 1/6 reduced scale model of the tank. Strain-gauges and displacement transformers were applied to the model to measure strains and displacements. Results of the reduced scale model show very good agreement between the theoretically computed stresses and the stresses determined in the model. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N66-16181*# AVCO-Everett Research Lab., Everett, Mass.
EXPERIMENTAL INVESTIGATION OF ADVANCED SUPERCONDUCTING MAGNETS Annual Report
Ethan D. Hoag Jul. 1965 69 p refs
(Contract NAS8-5279)
(NASA-CR-69883) CFSTI: HC $3.00/MF $0.75 CSCL 20D

Solutions are offered for the major obstacles encountered in the use of superconductors of Nb-25%Zr strip for the construction of large magnets. It is shown that anisotropy can be greatly reduced, although not eliminated, by a simple optimum anneal. In the final stages of annealing the lattice is generally softened, which gives rise to a lower normal resistivity and lower critical current. Truncation can be removed by stabilization. Data show that total current tends to be independent of the width of the strip, and truncation is negligible for strips of one millimeter or less in width. Copper stabilization allows the surface current to redistribute uniformly through the width in a stable fashion instead of only along the edges. For much of the short sample testing, the Nb-Zr strip was stabilized by clamping it tightly to the copper during the annealing. Since this results in a weak bond which will not withstand the bending and shock of coil winding, methods of laminating long strips were investigated. A copper plated strip, soft soldered to copper, was found to be most effective; and joints of this type were constructed with resistances well below 10^{-10} ohms. Two small superconducting disk solenoids for coil construction are described which are stable although not optimally designed. M.W.R.

N66-16184*# National Academy of Sciences—National Research Council, Washington, D. C.
DIELECTRICS—DIGEST OF LITERATURE, VOLUME 28, 1964
H. E. Bussey et al 14 Sep. 1965 389 p refs
(Contract NSR-09-012-902)
(NASA-CR-69880; NAS-NRC-1342) CFSTI: HC $7.00/MF $2.00 CSCL 20C

An annotated bibliography on dielectrics, based on a review of the current literature, is divided into ten chapters dealing with (1) *Instrumentation and Measurements*; (2) *Tables of Dielectric Constants, Dipole Moments, and Dielectric Relaxation Times*; (3) *Molecular and Ionic Interactions in Dielectrics*; (4) *Conduction Phenomena in Dielectric Solids*; (5) *Ferroelectric and Piezoelectric Materials*; (6) *High Polymeric Materials*; (7) *Inorganic Dielectrics*; (8) *Applications*; (9) *Insulating Films*; and (10) *The Breakdown of Dielectrics*. Overall reviews are presented for each of these subject headings. The second chapter contains tables which summarize data on the static dielectric constants of inorganic and organic pure liquids and pure solids; dipole moments for inorganic, organic, and metallic and nonmetallic-organic compounds as well as complexes and polymers; and unresolved relaxation times for organic compounds. M.W.R.

N66-16187*# Illinois Univ., Urbana. Coordinated Science Lab.
CALCULATIONS CONCERNING ELECTRICAL BREAKDOWN INDUCED BY THE MELTING OF MICROSCOPIC PROJECTIONS
Donald A. Lee Jan. 1966 41 p refs
(Grant NGR-14-005-038; Contract DA-28-043-AMC-00073(E))
(NASA-CR-69876; R-280) CFSTI: HC $2.00/MF $0.50 CSCL 20C

Calculations have been made concerning electrical breakdown induced by the melting of microscopic projections on the cathode surface. A digital computer analysis of tungsten shows a surprising correlation between measured electrical breakdown fields and the fields necessary to melt tungsten projections. Author

N66-16197# Ampex Corp., Redwood City, Calif.
STIFFNESS EFFECTS ON THE INFINITELY WIDE FOIL BEARING
A. Eshel and H. G. Elrod, Jr. Oct. 1965 34 p refs
(Contract Nonr-3815(00) (X))
(RR-65-11; AD-624827) CFSTI: HC $2.00/MF $0.50

Numerical solutions are presented for the film thickness of the infinitely wide, self-acting foil bearing for various values of tape stiffness. The solutions indicate that with increasing stiffness there are: a slow reduction in the nearly uniform clearance prevailing under most of the wrap angle; an increase in the peak of the undulations occurring in the region where the tape leaves the spindle; and virtually no change in the trough of these undulations. Author (TAB)

N66-16204# Brown Univ., Providence, R. I. Div. of Engineering.
ZERO-CUTOFF MODE IN DIELECTRIC-LOADED COAXIAL WAVEGUIDE Scientific Report No. 8
D. M. Bolle and M. D. Morganstern Jun. 1965 55 p refs
(Contract AF 19(628)-2498)
(AF-2498/8; AFCRL-65-722; AD-624617) CFSTI: HC $3.00/MF $0.50

Microwave ferrite isolators and phase shifters use partial dielectric loading to achieve the circular polarization essential to the operation of such devices. An approximate solution is developed for the lowest propagating mode in coaxial waveguide partially filled with dielectric. The solution is obtained by assuming a value for the propagation constant, and treating the problem as a perturbation of the zero-cutoff TEM mode which would generally exist in the guide were it filled homogeneously with dielectric. The points of maximum circular polarization are shown to lie on the dielectric interface roughly midway between the inner and outer conductors. Author (TAB)

N66-16245*# Midwest Research Inst., Kansas City, Mo.
RATIONAL APPROXIMATIONS TO THE GENERALIZED DUFFING EQUATION Final Report, 15 Jan.–14 Jan. 1966
Wyman G. Fair and Yudell L. Luke [1966] 25 p refs
(Contract NASr-63(07)); MRI Proj. 2760-P)
(NASA-CR-69893) CFSTI: HC $1.00/MF $0.50 CSCL 20K

A linear fractional transformation is used to obtain rational approximations to the response of a physical system which is described by a second order nonlinear differential equation which includes Duffing's equation as a special case. First, the general problem is stated and discussed. Second, the recurrence relations which define the approximations are developed. Third, some examples and applications which exhibit the uses and advantages of the rational approximations are shown. Finally, a Fortran program and its operating instructions are given. D.T.

N66-16246*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
TIME-DEPENDENT HYPERVIRIAL THEOREMS AND THE LIKE FOR VARIATIONAL WAVE FUNCTIONS
Saul T. Epstein 10 Jan. 1966 11 p refs
(Grant NsG-272-62)
(NASA-CR-69999; WIS-TCI-146) CFSTI: HC $1.00/MF $0.50 CSCL 20J

Conditions are given under which optimal variational wave functions will satisfy time-dependent hypervirial theorems, Hellmann–Feynman theorems, etc. Author

N66-16249*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
ELECTRONIC CHARGE DENSITY IN HELIUM IN THE FIRST ORDER SHIELDING APPROXIMATION
Jean H. Epstein and Saul T. Epstein 4 Jan. 1966 15 p refs (Grant NsG-275-62)
(NASA-CR-69849; WIS-TCI-145) CFSTI: HC $1.00/MF $0.50 CSCL 20J

An attempt was made to calculate electronic charge density, $\rho(r)$, as a function of nuclear charge, Z,

$$\rho(r) = \frac{Z^3}{\pi} e^{-2Zr}$$

taking into account the difference between the actual nuclear charge, Z, and an assumed nuclear charge, ζ. The result in terms of singularity, and agreement with exact values, was disappointing. D.T.

N66-16268 Joint Publications Research Service, Washington, D. C.
MEASURING THE DISTRIBUTION OF LIGHT IN THE FOCAL SPOT OF SOLAR COLLECTORS
V. B. Veynberg, G. Ya. Konayeva, and D. K. Sattarov *In its* Heliotechnol. 3 Jan. 1966 p 5–10 refs (See N66-16266 07-34) CFSTI: $3.00

A fiber-optical micrometer for direct measurement of irradiance in the focal spot of solar ray collectors is described. The main component of the instrument is a microphotometric gage consisting of a single one-stranded optical fiber in a light-tight envelope and a photometric device connected thereto. When measuring irradiance the input face of the optical fiber is placed in the investigated point of the light field and may be moved around in it. As is known, an optical fiber may have any aperture number, even one larger than unity, represented by $\sin u\sqrt{n^2-n_0^2}$, where u is the angle of incidence of rays on the fiber face and n, n_0 are the refractive indices of its interior and envelope. The rays enter the optical fiber input face and by multiple complete internal reflection spread along the fiber. The fiber output face is led up to the radiation receiver which can be either a thermoelement, photomultiplier, or other radiation indicator. M.R.W.

N66-16316# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
GENERALIZED TIME-SPACE PERIODIC MODULATION IN CYCLOTRON PARAMETRIC AMPLIFIERS
Edward S. Cassedy, Jr. 4 Mar. 1963 17 p *Its* Memo. No. 86 (Grant AF-AFOSR-62-295)
(PIBMRI-1133-63; AFOSR-65-1720; AD-624078) CFSTI: HC $1.00/MF $0.50

It is proposed to investigate the coupling of electron beam modes under the influence of parametric pumping fields. The effects of the complete set of time-space harmonics (idlers) are to be included in this study, as well as additional coupling mechanisms created by pump harmonics. A particular condition, called the 'synchronous harmonic condition', is predicted and proposed for theoretical and experimental study. None of the time-space harmonics may be neglected in this condition created by a traveling wave-quadrupole pumping field. This condition, fully explored, could be the basis for a new device: a 'synchronous (amplifying) harmonic generator'. A comprehensive study of parametric wave coupling in cyclotron devices is proposed with pump conditions ranging from D.C. (spatial periodicities only) to the idler type pump (time periodicity only) and various pump field configurations considered for the quantitative effects of amplification efficiency and extraneous coupling. TAB

N66-16338 Tata Inst. of Fundamental Research, Bombay (India).
THEORETICAL INVESTIGATION OF A RELAXING THREE LEVEL SYSTEM
Jayaseetha Premanand *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 97–101 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

A mathematical analysis and physical interpretation of a relaxing three level system is presented that describe the n level system in terms of an n×n density matrix. The quantum mechanical stochastic matrix $n^2 \times n^2$ satisfies certain properties which are analogous to the stochastic matrix and can be used in density matrices which remain diagonal throughout so that n×n densities and $n^2 \times n^2$ stochastic matrices are reduced to n×1 probabilities and n×n stochastic matrices. The properties of a 3×3 stochastic matrix are discussed in detail and a diagram for the probability current is given, together with a geometrical representation for the probability vector where the complex eigenvalues occur. G.G.

N66-16339 Indian Association for the Cultivation of Science, Calcutta.
INTENSITIES OF THE OPTICAL ABSORPTION SPECTRA OF OCTAHEDRAL COMPLEXES OF THE TRANSITION METAL IONS
Ardhendu S. Chakravarty and Andrew D. Liehr *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 102–104 (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Optical absorption spectra of the octahedral complexes of transition metal ions were studied by computing the electric dipole transition intensities between the various electronic

states. Considered were mixing of the d^n configurations with the $d^{n-1}p$ configurations under vibrational perturbations. The algebraic structure of the oscillator strengths of the electric dipole transitions of kd^n, (k=3,4,5), (n=1,2,3,4,5,6,7,8,9) complexes were derived and formal correspondence between their strengths deduced. Vibration constants were computed from integrals using hydrogenic wave functions with a variable effective nuclear charge, as well as other type wave functions. Oscillator strength was obtained by approximation and plotting as a function of effective nuclear charge. Requisite matrix elements were used to evaluate the electric dipole and quadrupole transitions. G.G.

N66-16403# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE SHORTWAVE ASYMPTOTIC OF THE SOLUTION OF THE PROBLEM OF A POINT SOURCE IN AN INHOMOGENEOUS MEDIUM

V. M. Babich [1965] 8 p refs Transl. into English from Vychisl. Mat. i Mat. Fiz. (USSR), v. 5, no. 5, 1965 p 949–951

Presented is a ray method of calculating the asymptotic shortwave expansion near the point source of an oscillation. Differentiation takes place along the ray issuing from the point along the extremes of the Fermat function. This expounded method of finding the asymptotic near the point source is closely associated with constructing the fundamental solution of the Cauchy problem for the wave equation of recursion systems of equations. G.G.

N66-16412# Holman (John F.) Co., Inc., Washington, D. C.

THE SPECTRAL-ENERGY DISTRIBUTION IN THE GROUND-GLASS IMAGE OF A SPHERE ILLUMINATED BY THE SUN, THE SKY AND REFLECTED LIGHT (CONCLUSION) [UBER DIE SPEKTRALE ENERGIEVERTEILUNG IM MATTSCHEIBENBILDE EINER VON SONNE, HIMMEL UND REFLEXLICHT BELEUCHTETEN KUGEL]

Nov. 1965 14 p refs Transl. into ENGLISH from Optik (Stuttgart), v. 7, no. 1, Jul. 1950
(Contract DA-44-009-AMC-930(T))
(ERDL-T-1810-65; AD-623920) CFSTI: HC $1.00/MF $0.50

The spectral-energy distribution of light reaching the photographic layer through the photographic lenses is investigated in relation to true color reproduction in photographic images. TAB

N66-16421*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.

CALCULATIONS OF THERMAL, FIELD EMISSION FOR A TERMINATED IMAGE POTENTIAL

James F. Morris Washington, NASA, 1966 612 p refs
(NASA-SP-3023) CFSTI: HC $6.00/MF $3.00 CSCL 20J

Computed properties are presented that characterize electron emission with a terminated image potential for fields from 10^8 to 10^8 volts per centimeter, temperatures from 0° to 3000° K, work functions from 1 to 8 volts, and Fermi levels from 1 to 15 electron volts. Theoretic electron-number and current densities, energy distributions and fluxes, and temperatures describe the electrons that escape over and through confining potential walls. Because the terminated image potential produces higher and wider emission barriers; its current densities fall below those for the ordinary (nonterminated) image potential at identical conditions. Where they apply, these theories probably bracket real thermal, field emission. Author

N66-16433# Joint Publications Research Service, Washington, D. C.

NATURE OF CURVED SPACE

N. Ya. Vilenkin 20 Jan. 1966 21 p Transl. into ENGLISH from Znaniye-Sila (Moscow), no. 11, Nov. 1965 p 7–10
(JPRS-33816; TT-66-30259) CFSTI: $1.00

The curvature of space by the mass of stars, galaxies, and other bodies of substantial mass are discussed and the measurement of curvature of a surface is considered. The concepts of Gauss and Riemann for the solution of the nature of the curvature of space and how to measure such curvature are described together with considerations of Einstein's concept that an appreciable curvature of space can be observed only near attracting masses, as was done by expeditions which observed the total solar eclipse of 1919. Also described is the proof of the curvature of space by observations of the planet Mercury. It is noted that the curvature of space must be taken into account in cosmological investigations where it is necessary to reckon with the curvature of space caused by the attraction of entire galaxies and metagalaxies. E.E.B.

N66-16434# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

NON RELATIVISTIC PARTICLES AND WAVE EQUATIONS

Jean-Marc Levy-Leblond Nov. 1965 65 p refs
(TH-112) CFSTI: HC $3.00/MF $0.75

This paper is a study of nonrelativistic particles and their properties, as described by Galilei invariant wave equations. The specifically relativistic properties of elementary quantum mechanical systems and those which are also shared by nonrelativistic systems are distinguished. Wave equations for nonrelativistic particles with any spin are constructed upon the theory of representations of the Galilei group, which define nonrelativistic particles. We particularly study the spin 1/2 case where we introduce a four-component wave equation, the nonrelativistic analog of the Dirac equation. It leads to the conclusion that the spin magnetic moment, with its Landé factor g=2 is not a relativistic property. More generally, nonrelativistic particles seem to possess intrinsic magnetic moments with the same values as their relativistic counterparts, but are shown to possess no higher electro-magnetic multipole moments. We show that only the displacement current is responsible for the breakdown of galilean invariance in Maxwell equations, and we make some comments about "nonrelativistic electromagnetism" and the very concept of wave equations. Author

N66-16448# Atomic Energy Establishment, Winfrith (England). Radiological and Safety Div.

CALCULATED ENERGY RESPONSE OF LITHIUM FLUORIDE FINGER-TIP DOSIMETERS

T. F. Johns Jul. 1965 20 p refs
(AEEW-M-550) HMSO: 2s 6d

Calculations have been made of the energy response of the lithium fluoride thermoluminescent dosimeters for the measurement of radiation doses to the finger-tips of people handling radio-active materials. It is shown that the energy response is likely to be materially affected in the sachet in which the powder is held contains elements with atomic numbers much higher than 9 (e.g. if the sachet is made from polyvinyl chloride). Author

N66-16453# Bureau of Mines, College Park, Md.

CALCULATION OF THE AVERAGE GROUND STRESS COMPONENTS FROM MEASUREMENTS OF THE DIAMETRAL DEFORMATION OF A DRILL HOLE

Louis A. Panek 1966 48 p refs
(BM-RI-6732)

Determining the change of stress in rock based on measurements of the deformation of a drill hole is a procedure that is increasing in popularity. A closely related procedure involves the application of this principle to determine the existing stresses in a rock medium, by cutting free (core drilling) an annulus containing the drill hole. In this report, expressions are derived from which one can calculate the stress ellipsoid—the three-dimensional change of stress, or the existing three-dimensional stress field, as the case may be. Study of these equations shows that the stress components in three dimensions can be determined by measurements in only two drill holes, and yields general principles that are useful in planning an efficient program of drilling and measurement. Procedures are given for calculating the least squares estimates of the stress components and their standard errors, and for evaluating or comparing calculated values by means of standard statistical inferences. Author

N66-16464# Lockheed Missiles and Space Co., Sunnyvale, Calif.

TRANSFER TRAJECTORY OF A VARIABLE-MASS POINT IN A CENTRAL FIELD

V. S. Novoselov [1965] 15 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), no. 19, 1965 p 147–156

The problem of point transfer along an ellipse between two coplanar circular orbits in a field of Newtonian-attractive forces is considered. The transfer is accomplished by velocity changes in the initial and final orbits. Account is taken of the influence of the time intervals of the velocity changes. Equations of motion are used in solving the problem, and expressions are given for the boundary conditions. Also investigated are the variational problem, for which Euler equations are evaluated; and a solution to terms of first order accuracy. From the calculations, it appears that when first order terms are taken into account, the transfer orbit is an ellipse whose eccentricity and parameter equal the corresponding values of the Homann ellipse. The energy expenditures in the transfer equal the expenditures in realizing the Homann ellipse for an impulse change in the velocity on the limiting circular orbits. The formulas obtained afford the possibility of constructing a first order transfer trajectory explicitly for a specific problem. L.S.

N66-16472# McGill Univ., Montreal (Quebec).

STUDY OF THE ORIGIN OF MICROPULSATIONS IN CERTAIN FREQUENCY BANDS Annual Report, Jul. 15, 1964–Jul. 15, 1965

[1965] 3 p refs
(Contract DA-49-092-ARO-G46)
(AD-622760) CFSTI: HC $1.00/MF $0.50

A search was made for possible man-made signals received at our permanent site at Mont St. Hilaire, Quebec, with no attempts made to locate sources of signals. Measurements were made in three pass bands, viz.: 1–40 Hz, 0.2–3 Hz, 0.01–0.2 Hz. TAB

N66-16515# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.

LYAPUNOV'S METHOD OF INVESTIGATING THE STABILITY OF MOTION OF RIGID BODIES WITH LIQUID-FILLED CAVITIES

V. V. Rumyantsev Nov. 1965 48 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1963 p 119–140
(RSIC-473; AD-624800) CFSTI: HC $2.00/MF $0.50

A survey and discussion are given of nonlinear methods for investigation of the stability of stationary motions of rigid bodies with liquid-filled cavities. Lyapunov's method differs considerably from the methods of linear theory, and, being mathematically rigorous, makes it possible to obtain sufficient effective conditions for stability in a whole series of cases. Author (TAB)

N66-16523# Brown Univ., Providence, R. I. Div. of Applied Mathematics.

WAVE PROPAGATION IN THE LINEAR THEORY OF VISCOELASTICITY

George M. C. Fisher and Morton E. Gurtin Aug. 1964 17 p refs
(Contract Nonr-562(25))
(TR-28; AD-604661) CFSTI: HC $1.00/MF $0.50

It was shown that, in the linear theory of viscoelasticity, the speed of propagation of an acceleration wave is a solution of a particular eigenvalue problem. It is demonstrated that this eigenvalue problem governs, not only the speed of propagation of acceleration waves, but also the propagation speeds of shocks and all higher order waves. Solutions which contain discontinuities of arbitrary order N are easily exhibited. TAB

N66-16555*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OPTICAL ABSORPTION COEFFICIENTS OF FUSED SILICA IN THE WAVELENGTH RANGE 0.17 TO 3.5 MICRONS FROM ROOM TEMPERATURE TO 980° C

Oliver J. Edwards Washington, NASA, Feb. 1966 25 p refs
(NASA-TN-D-3257) CFSTI: HC $1.00/MF $0.50 CSCL 20F

Among samples of the same optical grade from a given manufacturer, large variations occurred in the absorption at the ultraviolet absorption edge at 22° C. Samples exhibited absorption coefficients lying close to the mean absorption coefficient of samples with the same optical grade and manufacturer, at a wavelength of 180 millimicrons. The data show a general decrease in transmission with increasing temperature. The ultraviolet cutoff wavelength moves approximately 30 millimicrons toward the infrared between 22° and 982° C. The absorption peak at 1.4 microns moves approximately 10 millimicrons toward the infrared, while passing through a maximum in absorption around 260° C. The absorption peak at 2.2 microns moves some 17 millimicrons toward the infrared, while passing through a minimum. The absorption peak at 2.7 microns moves toward the ultraviolet up to about 260° C, then moves toward the infrared with increasing temperature; it monotonically decreases in absorption between 22° and 982° C. Author

N66-16659# Wayne State Univ., Detroit, Mich. Dept. of Chemistry.

DETERMINATION OF PARTICLE SIZE DISTRIBUTIONS IN EMULSIONS BY LIGHT SCATTERING

Bettye W. Greene (Ph.D. Thesis) 15 Nov. 1965 138 p refs
(Contract Nonr-3511(00))
(TR-14(60); AD-625540) CFSTI: HC $4.00/MF $1.00

The light scattering method for determining size distributions in liquid dispersoids was found applicable to the spontaneous dimethylnapthalene emulsions which contained submicronic particulates and were approximately 30% more heterodisperse than the synthetic heterodispersions of monodisperse lattices used to verify the method experimentally. A bi-parametric, exponential, postively-skewed distribution function closely approximating the distribution law commonly obeyed

by emulsions was assumed. The effect of stabilizer concentration, and the effect of aging on the size distribution of emulsions, was systematically investigated. Two scattering spectra, the turbidity and the scattering ratio as a function of wavelength, were obtained. Although the turbidity or transmission measurements are, in general, simpler and more accurate than those of scattering ratio, the turbidity spectra was found too insensitive to give an independent, unambiguous estimate of sizes in these moderately heterodisperse systems, electronic comparison and fitting of the experimental with the theoretical scattering spectra corresponding to various distribution parameters were accomplished with the IBM 7090 computer.

Author (TAB)

N66-16696*# Maryland Univ., College Park. Dept. of Physics and Astronomy.

TAUB-NUT SPACE AS A COUNTEREXAMPLE TO ALMOST ANYTHING Technical Report No. 529

C. W. Misner Nov. 1965 22 p refs Presented at the Am. Math. Soc. 1965 Summer Seminar on Relativity and Astrophys., Ithaca, N. Y., Aug. 1965

(Grant NsG-436)

(NASA-CR-70033) CFSTI: HC $1.00/MF $0.50 CSCL 20J

Discussed are the peculiar properties of the metric, $ds^2 = (t^2 + \ell^2)(d\theta^2 + \sin^2\theta d\phi^2) + U(t)(2\ell)^2(d\psi + \cos\theta d\phi)^2 + 2(2\ell)(d\psi + \cos\theta d\phi)dt$, where

$$U(t) = -1 + 2\frac{mt + \ell^2}{t^2 + \ell^2}.$$

It was shown that this metric satisfies the empty-space Einstein equation $R_{\mu\nu} = 0$. M.R.W.

N66-16768 Joint Publications Research Service, Washington, D. C.

PARALLEL MICROWAVE SUBSTITUTION METHOD FOR THE MEASUREMENT OF MICROWAVE DEVIATION

Tao-Ming Ch'en *In its* Transl. on Communist China's Sci. and Technol. No. 277 13 Jan. 1966 p 42–48 refs (See N66-16753 07-06) CFSTI: $2.00

A parallel microwave substitution method is presented for measuring microwave attenuation. Tests showed that the method overcomes the shortcomings of other methods and proved the stability of the output of the energy source and the amplifying rate of the indicator system has no effect on the result of the measurement. The method uses a parallel connection of the standard monitor and the measured monitor and the special characteristics of the magic T electric bridge for automatic comparison. The design of the measuring apparatus is shown. Experimental results of the serial method and the new parallel method under the same equipment conditions are tabulated and shows that measurements by the parallel method differ from the standard by about 1%, while the error of the serial method is as much as 4%. E.E.B.

N66-16774 Joint Publications Research Service, Washington, D. C.

EXPERIMENTAL METHOD OF DETERMINATION OF DEMAGNETIZATION FACTOR FOR HOLLOW BODIES USING THE MAGNETIC SCREENING METHOD

A. A. Preobrazhenskiy *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 41–45 refs (See N66-16766 07-14) CFSTI: $6.00

This paper presents an experimental method for the determination of the demagnetization factors of hollow bodies with the use of the magnetic screening phenomenon. The method has advantages over the previously known experimental methods with regard to simplicity of measurement and demonstrates accuracy which is adequate in practice. Author

N66-16798 Joint Publications Research Service, Washington, D. C.

STRUCTURE OF SURFACE LAYER OF POLISHED SILICON PLATES

T. P. Kapustina, T. G. Porokhova, and L. V. Tarnovskaya *In its* Izv. VUZov: Instr. Bldg., Vol. VIII, No. 5, 1965 24 Jan. 1966 p 195–202 refs (See N66-16766 07-14) CFSTI: $6.00

A study is presented of the structure of the surface layer of silicon plates with various methods of optical polishing; average values of the depth of micro-roughness and scratches produced during processing are given. Author

N66-16826# Stanford Univ., Calif. Stanford Linear Accelerator Center.

PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON MAGNET TECHNOLOGY

H. Brechna and H. S. Gordon, ed. 1965 903 p refs Symp. held 8–10 Sep. 1965; Sponsored in part by Calif. Univ. Supported by AEC

(CONF-650922) CFSTI: $8.50

Symposium papers in the fields of magnet technology and field analysis, magnet engineering, field measurement, superconducting and special purpose magnets, and power supply engineering are presented. For individual titles see N66-16827–N66-16914.

N66-16827 Stanford Univ., Calif. Stanford Linear Accelerator Center.

ELECTROMAGNETS FOR HIGH-ENERGY PHYSICS APPLICATIONS

H. Brechna *In its* Proc. of the Intern. Symp. on Magnet Technol. 1965 p 1–26 refs (See N66-16826 07-23) CFSTI: $8.50

The multi-functional purpose of powerful electromagnets to be used for high-energy physics applications requires specific features such as magnetic field strength, field homogeneity in a requested space, field configuration and distribution, resolution, solid angle, dispersion and focusing properties. These demands are easily met if boundary conditions such as dimensional and material limitations, geometrical and environmental effects, power consumption, and adequate cooling are not restricted. The paper deals with magnets which fulfill as closely as possible the above requirements, considering actual limitations given by conditions in laboratories as well as dimensional, geometrical, and material properties. An approach to designing iron-bound magnets using Fabry factors is given. Coil configuration, pole form and shaping, iron boundaries; impurities in ferromagnetic materials, cooling methods and media, and magnet performance are explored. Magnet design features such as reliability, choice of conductor, magnetic materials, and coil insulation are included. Coil damage due to fatigue, electrical breakdown, moisture and other influences on insulation, and environmental conditions are discussed. Author

N66-16828 European Organization for Nuclear Research, Geneva (Switzerland).

SOME ASPECTS OF MAGNET TECHNOLOGY IN HIGH ENERGY EXPERIMENTAL PHYSICS

C. A. Ramm *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 27–55 refs (See N66-16826 07-23) CFSTI: $8.50

Aspects of the present state of magnet technology in high energy experimental physics are illustrated by describing recently constructed magnets. Examples of precise spatial and time dependent magnetic fields and of the requirements for beam optics are given. Techniques for pulsed magnetic fields, for bending and focusing devices, for measuring magnetic moments, and for the production of neutrino beams are discussed. Industrial procedure for the construction of large coils and yokes is briefly outlined. Author

N66-16829 Stanford Univ., Calif. Stanford Linear Accelerator Center.

CURRENT MAGNET DESIGN PRACTICES IN THE U.S.A.

H. Brechna, J. J. Grisoli (Brookhaven Natl. Lab.), H. Paul Hernandez, Robert A. Kilpatrick (Calif. Univ.), Reynold J. Krizek (ANL) et al *In its* Proc. of the Intern. Symp. on Magnet Technol. 1965 p 56–78 refs Prepared jointly with Brookhaven Natl. Lab., Calif. Univ., and ANL (See N66-16826 07-23) CFSTI: $8.50

Magnets in use at the Argonne National Laboratory, the Lawrence Radiation Laboratory, the Stanford Linear Accelerator Center and the Brookhaven National Laboratory are described. Types of cores, core construction and coil design are reviewed with the intention of giving a broad picture of the current magnet design practices in the U.S.A. Many aspects are common to all the laboratories. Author

N66-16830 California Univ., Berkeley. Lawrence Radiation Lab.

MAGNET SYSTEMS: POWER SUPPLIES: COST OPTIMIZATION

Charles G. Dols *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 79–83 (See N66-16826 07-23) CFSTI: $8.50

As the number of auxiliary magnets for particle accelerators increases, it becomes increasingly important that some of the designs be standardized. More attention will therefore be paid to cost optimization of the standard magnet designs. In this paper we present significant concepts and elements that enter into such cost optimization. A typical auxiliary-magnet system is first described. Then the factors that enter into cost optimization are discussed, with some examples given. These factors include power duty factors; incremental costs; and present value, including interest rate and useful life. Finally an expression for optimum current density in magnet conductors is derived. Author

N66-16831 Massachusetts Inst. of Tech., Cambridge.

CONVERTING AN ION-OPTICAL LAYOUT INTO THE DESIGN OF A PRACTICAL MAGNET SYSTEM

Harald A. Enge *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 84–88 refs (See N66-16826 07-23) CFSTI: $8.50

A discussion is first given of how to design a beam-deflecting magnet or spectrograph so as to retain a high accuracy up to reasonably high inductions. The second part of the talk deals with ion-optical problems associated with the fact that the fringing fields of magnets do not have sharp cut-offs as assumed in most ion-optical calculations. Author

N66-16832 European Organization for Nuclear Research, Geneva (Switzerland).

THREE-DIMENSIONAL POTENTIAL FUNCTIONS FOR MAGNET DESIGN

Bengt Hedin *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 89–95 refs (See N66-16826 07-23) CFSTI: $8.50

Examples of potential functions are given as a guide for proceeding with three-dimensional field calculations. Two-dimensional functions are discussed in the sense that the potential has been a function of only two variables: either x and y, or r and z. Expressions are given for the potentials of the quadrupole field, a pair of magnetic dipoles, and the cyclotron field; figures depicting these fields are included. For three-dimensional calculations, formulas are given for describing the alternating gradient field, rectangular field pattern, and ball-shaped fields. Plots show the equi-field lines for alternating gradient field formula with n = 2; and the equi-field and the equi-potential lines for the rectangular field formula. M.G.J.

N66-16833 Commissariat a l'Energie Atomique, Saclay (France).

CALCULATION OF THE MAGNET PROFILE BY THE METHOD OF EQUIVALENT CURRENTS

G. Bronca, Joseph Hamelin, and S. Jaidane *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 96–103 refs (See N66-16826 07-23) CFSTI: $8.50

A distribution on a magnetic plane of current sheets with variable density gives the desired field in the air gap. The current density is given as a polynomial function, the effect of each term is analyzed in the magnetic field, and adjustment of the function is made to get the right law. The calculation takes into account the effect of the yoke and the coils. The desired magnetic equipotential line is then calculated. Applications are made to synchrotron magnet profiles. Author

N66-16834 Nevada Univ., Reno.

THE USE OF CONFORMAL TRANSFORMATION IN MAGNET DESIGN AND THE EXTENSION OF THE SCHWARZ-CHRISTOFFEL TRANSFORMATION

Andrew A. Halácsy *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 104–110 refs (See N66-16826 07-23) CFSTI: $8.50

Using the theory of complex potentials, a transformation equation is derived which conformally maps one-half of a "t" plane, at one side of a straight line into the interior of a curve-sided polygon on a "z" plane. Author

N66-16835 Varian Associates, Palo Alto, Calif.

THE DESIGN OF VOLUME-MINIMIZED-SPLIT SOLENOID SYSTEMS

H. C. Hitchcock *In* Stanford Univ. Proc. of the Intern. Symp. On Magnet Technol. 1965 p 111–125 refs (See N66-16826 07-23) CFSTI: $8.50

A procedure for the design of volume-minimized, symmetrically-separated, right solenoid pairs, excited with a uniform winding current density is discussed. As this system can be completely described geometrically by three variables, two of which are determined by the field requirement and the assumption of volume minimization, we can fix its design by imposing a constraint on the field homogeneity as expressed in a zonal harmonic expansion. The formal procedure may be generalized to systems with n geometry factors by requiring that the (2n-4)th error coefficient in the zonal-harmonic expansion vanish. Author

N66-16836 European Organization for Nuclear Research, Geneva (Switzerland).

THE ORTHOGONAL ANALOGUE MODEL HELPS TO SOLVE MAGNETIC FIELD PROBLEMS DIFFICULT TO BE TREATED BY ANALYTICAL METHODS

A. Ašner, P. Bossard, and Ch. Iselin *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 126–140 (See N66-16826 07-23) CFSTI: $8.50

Orthogonal analog model measuring equipment and its application to problems, where a purely analytical approach and/or checking by magnetic measurements would be difficult, demonstrated by the following examples: a) The determination of the "Split-Pole"-quadrupole teeth configuration in order to correct the effect of the quasi-sine distributed, lumped excitation coils and of saturation. b) The correction of the CERN-PS fringing field was crossed by the slow extracted beam. The fringing field has partly been linearized by a freely inserted shim-neutral pole combination and partly made constant by special magnetic screens. c) The determination of the PS-pole-face winding current repartition at injection in order to compensate for the magnetic field and gradient distortion caused by eddy currents in vacuum chambers of different size. The analog model rapidly provides the right compensation in the region where the pole profile is no longer hyperbolic and the $w = z^2$ transformation not exact. Since small field and gradient errors superposed to the low injection field values are involved, final measurements on the model with only distortion and correction effects simulated are simpler, more accurate, and conclusive. Author

N66-16837 Stanford Univ., Calif. Stanford Linear Accelerator Center.

A GENERAL FIRST-ORDER AND SECOND-ORDER THEORY OF BEAM TRANSPORT OPTICS

Karl L. Brown *In its* Proc. of the Intern. Symp. on Magnet Technol. 1965 p 141–153 refs (See N66-16826 07-23) CFSTI: $8.50

A general first- and second-order theory of beam transport optics has been developed. From this the first- and second-order matrix elements of bending magnets, quadrupoles and sextupoles have been derived. Utilizing this theory, very general first- and second-order theorems of beam transport optics have been formulated which have been extremely useful for designing simple and multiple element magnetic optical systems. The theorems are expressed as functions of five characteristic first-order trajectories of a system. In fact, all of the first- and second-order optical properties of a system may be expressed in terms of these five trajectories. A general discussion of the formulation and the results obtained will be presented along with typical examples to illustrate their usefulness. Author

N66-16838 National Bureau of Standards, Washington, D. C.

MEASUREMENT OF ION-OPTICAL PROPERTIES OF A HIGH RESOLUTION SPECTROMETER FOR ELECTRON SCATTERING

Samuel Penner and J. W. Lightbody *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 154–163 refs (See N66-16826 07-23) CFSTI: $8.50

A double focusing magnetic spectrometer for electron scattering work is described. The spectrometer has been ray traced using positive ions from a 400 keV Van de Graaf accelerator. A large number of rays are traced and fitted to a second order transfer matrix by a least-squares technique. Selected third order effects are also included. A comparison of measured matrix elements with theoretical predictions is presented. Agreement with theory is good. The intrinsic resolution of the instrument (for a point source) is approximately 1 part in 10^4 FWHM using the maximum solid angle allowed by the vacuum chamber. Author

N66-16839 California Univ., Berkeley. Lawrence Radiation Lab.

ON THE CALCULATION OF NONLINEAR MAGNETOSTATIC FIELDS

Paul Concus *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 164–169 refs (See N66-16826 07-23) CFSTI: $8.50

The numerical solution of the second-order, elliptic, quasi-linear, partial-differential equation arising in a two-dimensional magnetostatic field problem, where the permeability varies with the field, is considered. The most widely used method for solving this problem is a successive approximation method based upon a linearization for small magnetic-field strengths. At each step the method solves a linear problem which is obtained by using a permeability calculated from the field at previous steps. For large field strengths, however, the behavior of the magnetic material is so nonlinear as to render the method poorly convergent. In this paper, a numerical method is considered which more fully takes into account the nonlinear features of the problem. It is based on the iterative solution, but the method of nonlinear successive overrelaxation, of a set of nonlinear difference equations approximating the original differential equation. Favorable results are obtained in a comparison between the method and the usual small-magnetic-field approach for the numerical solution of a test problem. Author

N66-16840 California Univ., Livermore. Lawrence Radiation Lab.

MAGNETIC FIELD CALCULATIONS IN AN IRREGULAR TRIANGLE MESH

Alan M. Winslow In Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 170–181 refs (See N66-16826 07-23) CFSTI: $8.50

A method is described for the numerical solution of the nonlinear magnetostatic equation for the vector potential over an arbitrary polygonal region using a distorted triangle mesh. The equations are solved by successive overrelaxation with automatic optimization of the overrelaxation parameter. Based on this method, a general purpose two-dimensional magnet code has been developed which will calculate magnetic fields in any plane arrangement of air, iron, and currents, with speed and accuracy comparable to that obtained with rectangular meshes. Author

N66-16841 California Univ., Berkeley. Lawrence Radiation Lab.

MAGNET DESIGN APPLICATIONS OF THE MAGNETOSTATIC COMPUTER PROGRAM CALLED SIBYL

Joseph H. Dorst *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 182–187 refs (See N66-16826 07-23) CFSTI: $8.50

The computer program SIBYL, used extensively in the design studies of magnets for a 200-BeV synchrotron was written for static evaluation of two-dimensional magnets including the effects of finite non-uniform permeability of the iron. The general operation of the code and some of the special features are described. The code is especially useful for studying small differences between similar magnets. Applications include evaluation of the effects of iron saturation as a function of current, shaping of the pole base of AGS-type gradient magnets, shaping of magnet poles for good medium-field profiles, and partial evaluation of quadrupole magnets. The validity or accuracy of the computed results is discussed. The comparisons of calculated and measured fields of the CERN Proton Synchrotron Magnet indicate the attainable quality of computed results. At 14.4 kG, within the limits of the vacuum chamber, the gradient computed by SIBYL was within 1% of the measured gradient. Author

N66-16842 California Univ., Berkeley. Lawrence Radiation Lab.

MAGNET DESIGN APPLICATIONS OF THE MAGNETOSTATIC PROGRAM CALLED TRIM

John S. Colonias and Joseph H. Dorst *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 188–195 refs (See N66-16826 07-23) CFSTI: $8.50

This paper discusses work being done in computing magnetic fields with the magnetostatic program called TRIM for the design of quadrupole and sextupole magnets. The irregular triangular mesh utilized by this program allows the computation of fields for both symmetric and asymmetric magnets of any shape. The program is so general that it permits any distribution of currents, several kinds of iron in the same magnet, and voids or currents within the iron. The attainable quality of the computed results is evidenced by comparing with (1) measurements at the CERN proton synchrotron magnet and (2) analytical solutions of simple geometries including an ideal quadrupole. Agreement with CERN measured gradients is within 1%, within the limits of the vacuum chamber. While the present coding permits evaluations of medium accuracy, the full potential of this program has not yet been realized. Author

N66-16843 California Univ., Berkeley. Lawrence Radiation Lab.

COST ESTIMATING MAGNET SYSTEMS WITH THE AID OF A COMPUTER

H. Paul Hernandez, Raymond W. Schwarz, and R. B. Yourd *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 196–207 ref (See N66-16826 07-23) CFSTI: $8.50

Computer programs were found to be effective aids in parameter optimization and preliminary cost estimations for magnet systems. The COMA Fortran program, which can be used to compute 12 basic magnet geometries, was used with an EFFIC subroutine on a 6-meter spherical bubble chamber magnet. Magnetic fields up to 70 kG were studied, and optimum coil dimensions and core thicknesses were found. At 50 kG, total cost for an operating time of 20 000 hr was found to be $32 000 000. An MAGHYP program was used in the parameter selection and cost estimate for an 8-BeV injector synchrotron gradient magnet system. Cost optimization studies indicated that parameter selections can be made more accurately than future market requirements can be predicted. Other magnet design cost applications are possible with these computer programs. M.W.R.

N66-16844 Stanford Univ., Calif. Stanford Linear Accelerator Center.

QUADRUPOLE MAGNET DESIGN

Edward A. Taylor *In its* Proc. of the Intern. Symp. of Magnet Technol. 1965 p 208–217 refs (See N66-16826 07-23) CFSTI: $8.50

A method of computing the quality of field in a quadrupole magnet by means of two-dimensional relaxation is described. The vector potential field at every point in the gap and in the copper is derived, using the given pole tip contour and an irregular pattern of current inputs and assuming infinitely permeable iron. The vector potential is used to calculate flux density at any point in the gap and to estimate flux density in the iron boundaries and in return yokes, and to estimate the inductance of the magnet. The field quality is expressed in terms of its harmonic coefficients, which are directly measurable on the actual magnet. The results of several calculations are presented, which show the effect of changing the location of the windings adjacent to the aperture. Author

N66-16845 European Organization for Nuclear Research, Geneva (Switzerland).

THE CERN SLIM BEAM TRANSPORT ELEMENTS

A. Asner *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 218–238 refs (See N66-16826 07-23) CFSTI: $8.50

Details are given on the development of slim beam transport elements, consisting of two slim lenses, split-pole quadrupole, and figure-of-eight quadrupole, with a corresponding high power, slim C-type, window frame 17 kG bending magnet. In the slow ejection quadrupoles and bending magnets, a current density of ≈ 50 A/mm^2 at two turns per water coiling circuit was reached. By using delrin-block manifolds at both ends of the magnets, and cooling each half-turn separately, the current density can be doubled to 100 A/mm^2 at still conventional temperature rises of $\Delta\theta \approx 50°$ C, and pressure drops of $\Delta p \leq 15$ kg/cm^2. Considering that the silicon-controlled rectifier power supplies can be pulsed with a 2–2.5 times higher flat-top current during 300 ms at a repetition rate of 1 s, peak current densities of some 300 A/mm^2 can be achieved. It is pointed out that with this current density, the overall dimensions of the slow ejected beam quadrupole lenses and bending magnet could be reduced to 13×28 cm^2. M.G.J.

N66-16846 Institute of Physical and Chemical Research, Tokyo (Japan). Cyclotron Lab.

A B-CONSTANT MAGNET POLE DESIGN

Takashi Karasawa, Shoshichi Motonaga, Yoshitoshi Miyazawa, Noriyoshi Nakanishi, Masataka Hanmi, et al *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 239–247 refs (See N66-16826 07-23) CFSTI: $8.50

The shapes of the pole in which the magnetic induction B of iron is constant are presented for a wide range of ratios of diameter to gap. The shapes are derived from a simple equation with a correction factor k as a function of the ratio of the diameter to the gap. The constancy of B was experimentally confirmed. Author

N66-16847 Midwestern Universities Research Association, Stoughton, Wis.

CONTOURED POLES FOR DC ACCELERATOR MAGNETS

Ronald W. Fast and Richard S. Christian *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 248–252 refs (See N66-16826 07-23) CFSTI: $8.50

The problem of reducing the pole excitation required in the high field region is examined, along with the need of maintaining the desired median plane fields. Details are given on the machining of the pole, which was done on a numerically controlled milling machine with a ball tool radius of one inch. Eleven J-cuts and 60 I-cuts were used, with a minimum of overlapping; number of points totaled 3500 per pole. The final computer output was a magnetic tape listing approximately 70 cuts, each cut containing many (x_c, y_c, z_c) points. The median plane magnetic field was measured with a rotating-coil gaussmeter accurately located in the gap. For convenient computer analysis, digital voltmeter-punched card readout was used. It was concluded that the good agreement obtained indicated that the contouring pole technique is basically correct. M.G.J.

N66-16857 Argonne National Lab., Ill.

SELECTION OF WATER-COOLED CONDUCTORS FOR DC MAGNETS

Israel Pollack *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 349–355 *ref* (See N66-16826 07-23) CFSTI: $8.50

A step-by-step procedure for selecting a water-cooled hollow conductor for DC magnets is outlined. A graphical solution for determining the coolant hole diameter is presented. This solution, plotted as a function of power per water circuit per water temperature rise for various values of the parameter $\Delta p/al$ (pressure drop per equivalent flow length) substantially reduces calculation time. Author

N66-16860 Institute of Physical and Chemical Research, Tokyo (Japan). Cyclotron Lab.

ON A CIRCULAR CURRENT SHIM FOR A CYCLOTRON MAGNET

Noriyoshi Nakanishi, Shoshichi Motonaga, Yoshitoshi Miyazawa, and Takashi Karasawa *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 377–389 refs (See N66-16826 07-23) CFSTI: $8.50

A correction of the radial distribution of the magnetic field by the circular current through the windings on the surface of the pole tip was studied experimentally and theoretically. Change of permeability of iron at high magnetic field was investigated, and agreements were found between experimental results and numerical calculations. The magnetic field produced by a circular current shim near the edge of pole tip is affected by local saturation of iron. The shape of current shims on the 160 cm magnet for the ordinary type variable enery cyclotron is presented. These methods may be also applied to A.V.F. cyclotron. Author

N66-16861 California Univ., Berkeley. Lawrence Radiation Lab.

TECHNIQUES OF MAGNETIC-FIELD MEASUREMENT

Peter G. Watson and Ronald F. Di Gregorio *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 393–406 refs (See N66-16826 07-23) CFSTI: $8.50

A survey of the most useful techniques of magnetic measurement is presented. Emphasis is placed on the inherent advantages and limitations of each method, on recent improvements, and on the degree of accuracy attainable at present. Magnetic measuring systems are considered. Factors such as positioning equipment, data recording and processing, and overall cost of measurement are discussed in terms of two systems: the "search-coil Zip-Track" system and the "Rapid Mapper." Author

N66-16864# Brobeck (William M.) and Associates, Berkeley, Calif.

THE DETERMINATION OF MEDIAN PLANES IN CYCLOTRONS WITH HALL PLATES

Charles G. Smith *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 421–427 (See N66-16826 07-23) CFSTI: $8.50

The location of the median plane has been determined for a large synchrocyclotron magnet using Hall plates rather than the more conventional floating wire technique. The Hall plates are used to measure the horizontal field component, which is normally a few gauss in the presence of the vertical field component of approximately 20 kilogauss. This paper describes the equipment used to maintain the high angular accuracy required for this measurement. Results from measurements made on a 600 MeV Synchrocyclotron magnet and a discussion of accuracy are also presented. Author

N66-16866 Stanford Univ., Calif. Stanford Linear Accelerator Center.

SPECTROSCOPY OF QUADRUPOLE MAGNETS

J. Cobb and R. Cole *In its* Proc. of the Intern. Symp. on Magnet Technol. 1965 p 431–446 (See N66-16826 07-23) CFSTI: $8.50

A measurement technique, spectroscopy of multipole fields, is presented. The technique enables one to determine certain parameters of multipole magnets. It is shown that one can use these parameters to express the vector magnetic induction of a quadrupole magnet in closed analytical form. Author

N66-16868 Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

BEAM TRANSPORT MAGNET MEASUREMENTS AT DESY

K. Holm and Klaus G. Steffen In Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 456–466 refs (See N66-16826 07-23) CFSTI: $8.50

A number of standard beam transport magnets are in use, which were designed for high field linearity and acceptance. In order to facilitiate full use of these magnets, it is intended to determine from field measurements the precise optical transformation coefficients up to third order for the quadrupoles and up to second order for the bending magnets. For this purpose, a precise semiautomatic Hall probe measuring system has been put in operation which will enable us to take, within a few days, on the order of 40000 data for each magnet prototype on punch cards. The system and preliminary results characterizing the magnet performance are described. The accuracy in probe position is ± 0.02 mm, and in field strength ± 0.5 G. Author

N66-16871 Brookhaven National Lab., Upton, N. Y.

COSMOTRON MAGNETIC FIELD MEASUREMENTS

John C. Alderman, Jr. and G. H. Morgan *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 476–482 refs (See N66-16826 07-23) CFSTI: $8.50

A complete remapping of the field of the Cosmotron magnet has been undertaken. Previous measurements of the field were made as a function of time during a pulse; and are presently not useful because several major changes, made since the original construction, affect the rate-of-rise of the field. The new measurements are referred to the integrated voltage of the B-dot windings which encircle all four quadrants, i.e., to an average field. The measurements are semi-automated by a system of solid-state switching logic which records most of the data on paper tape for computer analysis. Measurements of field are made to an accuracy of better than 0.1%, and of gradient, using paired coils interchanged between pulses, to an accuracy of 1%. Author

N66-16873 Auburn Univ., Ala.

SEARCH COIL MEASUREMENTS OF THE HARMONIC CONTENT OF BEAM TRANSPORT MAGNETS

William H. Lamb, Jr. and Robert J. Lari (ANL) *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 487–496 refs (See N66-16826 07-23) CFSTI: $8.50

This paper derives the design equations for a rotating search coil to measure the harmonic content of beam transport magnets. The independent variables are chosen to make the search coils insensitive to the lowest harmonic. A wave analyzer is used to measure the output voltage at the higher harmonics and enables one to calculate the harmonic coefficients. The results of measurements made on a quadrupole magnet are given and agree with theoretical calculations. Author

N66-16876 Paris Univ., Orsay (France). Institut d'Electronique.
A HIGH HOMOGENEITY-HIGH FIELD SUPERCONDUCTING MAGNET FOR NUCLEAR RESONANCE
P. Grivet and M. Sauzade *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 517–524 refs (See N66-16826 07-23) CFSTI: $8.50

A superconducting coil is used to provide a highly homogeneous and stable magnetic field, which also has high intensity and sensitivity. A solenoid, with compensating coils, increases homogeneity and balances the hysteresis effect inherent to the use of hard superconductors. A maximum usable field of 58 kG is attained which has an homogeneity of 10^{-7} over a 150 mm^3 volume. This was checked by registering the ethyl alcohol spectrum at 37 kG with a nonrotating sample. These experiments indicate that a superconducting coil is effective for use in nuclear magnetic resonance spectroscopy. M.W.R.

N66-16893 California Univ., Berkeley. Lawrence Radiation Lab.
DESIGN PROBLEMS ASSOCIATED WITH HIGH-CURRENT-DENSITY WATER-COOLED SEPTUM MAGNETS
Michael A. Green *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 643–649 refs (See N66-16826 07-23) CFSTI: $8.50

Problems associated with high-current-density septa are summarized. Criteria for the design and fabrication of high-current-density magnets are listed as follows: (1) Avoid the use of high-current-density conductors. (2) Minimize the vertical aperture of high-current density septum. (3) Do not allow the copper temperature at the tube wall to exceed the water boiling temperature. (4) Optimize the conductor for current-carrying capacity. (5) Minimize the number of turns in the magnet. (6) Avoid the use of nonradiation-resistant insulations. (7) Use high-speed temperature sensors, which are essential at the hot end of each cooling circuit to prevent conductor burnout due to cooling failures. (8) Avoid many cooling system problems by maintaining the purity of the cooling water. (9) Investigate conductive heat transfer from the copper to the water when the current densities are very high or when the heat path passes through materials of low thermal conductivity. E.E.B.

N66-16897 Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
MEGAGAUSS MAGNETS USING CAPACITOR DISCHARGES
Francis Bitter *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 680–683 refs (See N66-16826 07-23) CFSTI: $8.50
(Contract DA-36-039-AMC-03200(E))

Plans are described for producing magnetic fields in the 1–5 megagauss range in single turn coils a few millimeters in diameter by the oscillatory discharge of a 20 kilojoule capacitor having a quarter period less than 1 μsec. Author

N66-16902 Borough Polytechnic, London (England). Dept. of Physics.
AN ACHROMATIC 90° BENDING MAGNET SYSTEM
D. D. Randall *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 715–722 refs (See N66-16826 07-23) CFSTI: $8.50

An achromatic magnet system was required to bend a beam of nominally 100 MeV. electrons through 90° and on to a target 7 cm. diameter about 6 metres from the original beam direction. The bending system had to cater for a total beam energy spread of 6 MeV and an initial beam diameter of 5 cm. Solution of this requirement is considered using two 45° bending magnets and a single quadrupole between them. The residual deviations and divergences expected are calculated also. Author

N66-16903 Magnetic Engineering Associates, Boston, Mass.
A 100 KILOGAUSS QUASI-CONTINUOUS CRYOGENIC SOLENOID, PART I
Laszlo M. Lontai and Peter G. Marston *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 723–732 Prepared for Mc Gill Univ. Sponsored by Natl. Res. Council of Canada

An analysis is made of the region of maximum stress near the midplane of a 100-kilogauss quasi-continuous cryogenic solenoid. The Lorentz body force in a conductor is discussed, as are hoop stress in a self-supporting current sheet, radial distribution of the tangential and radial stresses in a solenoid, relationships between magnetic field and maximum stress, and stress reduction by electrical regionalization. Both general results and specific results for the cryogenic coil are included. Design of the cryogenic coil was governed by the low yield strength of the high purity aluminum conductor used. Current density ratio of the coil configuration is .85 for the second electrical region in relation to either the first or third. Maximum operating stress is about 6000 psi at 100 kilogauss, and total conductor weight is about 104 pounds. M.W.R.

N66-16906 Brown, Boveri and Co., Ltd., Baden (Switzerland).
MAGNET-SYSTEM POWER SUPPLIES
Fritz Grütter *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 755–768 refs (See N66-16826 07-23) CFSTI: $8.50

This paper reviews briefly those methods for powering constant excited and pulsed magnets which have found general application, especially in the field of high energy particle physics. While for constant field magnets motor-generator sets have almost exclusively been used until recent years, the trend is actually towards rectifiers using solid-state devices up to the highest power ratings. For large slowly pulsed magnets, such as guiding magnets for high energy proton synchrotrons, motor-alternator sets followed by static power converters are considered best suited, but mercurty-arc tubes for power conversion are obsolescent and will in the future also be replaced by solid state devices. Rapid-cycling high-energy synchrotrons use a resonant circuit with a dc bias, in which sections of the magnet and energy storage capacitors alternate to keep the voltage to a practical level. For accelerators which are in the planning stage all-electronic circuits are proposed to supply dc and ac, or pulsed power, as the case may be, to the resonant system. A few remarks are added about power supplies for magnets requiring short current pulses with peaks of hundreds or thousands of kiloamperes. Author

N66-16914 Stanford Univ., Calif. Linear Accelerator Center.
ESTABLISHING THE MAGNETIC FIELD OF A SOLID POLE MAGNET TO WITHIN ±0.01%
C. A. Harris and J. K. Cobb *In its* Proc. of the Intern. Symp. on Magnet Technol. 1965 p 823–834 refs (See N66-16826 07-23) CFSTI: $8.50

The problems associated with setting the fields of several magnets in series using only current as an indicator for the calibration of the magnetic field are summarized. It is shown that the rate at which the magnet current is allowed to

change, even for short periods of time, can change the calibration of the magnet by 0.3%. A fast rate of change of current during the energizing cycle results in a higher magnetic field than when the current is raised slowly. It is possible to set the magnets in the BSY to an accuracy of 0.01% by current alone, if the rates of current changes in the series of magnets that make up the deflection system are carefully controlled. It appears that the rate should be set at about 6 amperes per sec. This rate is well within the capability of the power supply run-up system and results in a residual field of about 9 gauss for all current settings over approximately 7500 gauss. Certain recommendations are given for selection of the magnets to make up the system and for setting of the system when installed in the BSY. E.E.B.

N66-16927# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Flugmechanik.
PROBABILITIES OF MEETING OF TWO MOVING OBJECTS [BEGEGNUNGSWAHRSCHEINLICHKEITEN ZWISCHEN BEWEGTEN OBJEKTEN]
F. Hammelrath Sep. 1965 55 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-42) CFSTI: HC $3.00/MF $0.50

For the investigation of the probability of meeting of two objects which move in a space being subject to a finite number of random parameters, a general formula is laid down by using vectors and matrices. Assuming that a meeting has no effect on the further motion of the two objects, the expected value for the number of meetings is obtained; it is equal to the probability of meeting, if one meeting only is possible or the probability of another one and more meetings is so low that they may be neglected. As an example, the probability of meeting is calculated with obvious assumptions and it is shown, how the calculation can be made easily understandable by consequently using vectors and matrices. The necessary fundamentals of the theory of probability with multidimensional random variables are given in two separate sections. Author

N66-16979*# Illinois Univ., Urbana. Dept. of Electrical Engineering.
PROPAGATION OF EM WAVES IN LINEAR, PASSIVE, GENERALIZED MEDIA Scientific Report No. 9
Oren B. Kesler Oct. 1965 162 p refs *Its* Antenna Lab. Rept.-65-9
(Grant NsG-395)
(NASA-CR-70212) CFSTI: HC $4.00/MF $1.00 CSCL 20N

Properties of linear passive media are investigated by using a phenomenological approach. Properties of fields that can propagate in a passive medium are postulated and from this properties of the constitutive relationship are deduced. A necessary positive real condition on the constitutive relationship is found and some of its implications are considered. Also, the causality condition which is necessary for realizable media is considered. Next a general formulation of the spectrum of characteristic waves in lossless linear passive media is made. Because of an orthogonality condition for the characteristic waves of the medium, the fields due to an arbitrary source can be separated into components parallel to the characteristic waves. The components of the source field are dependent only upon the portion of the source parallel to their characteristic field and to their own sheet(s) of the dispersion surface. The theory is then applied to two particular problems, electric dipoles in a general time-dispersive uniaxial medium and in an isotropic compressible plasma. Finally, the radiation field of an arbitrary source in a lossless linear passive medium is investigated using the spectral decomposition of the fields. Author

N66-16993# RAND Corp., Santa Monica, Calif.
RADIATIVE TRANSPORT AND THE CALCULUS OF VARIATIONS. I: THE INVARIANT VARIATIONAL PRINCIPLE AND NORMAL INITIAL AND BOUNDARY DATA
Dominic G. B. Edelen Dec. 1965 25 p refs
(P-3275; AD-624777) CFSTI: HC $1.00/MF $0.50

The problem of three-dimensional radiative transport is imbedded in a variational principle (preferably invariant under analytic coordinate transformations). The requisite invariant variational principle is obtained. The symmetry properties of such problems are examined for normal scattering kernels. TAB

N66-17003# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONVERTER OF ELECTROMAGNETIC WAVES INTO HYPERSONIC WAVES
Ye. M. Ganapol'shiy and A. N. Chernets 9 Nov. 1965 6 p Transl. into ENGLISH from Russian Patent no. 164038 (Appl. no. 729611/26-9, 27 Aug. 1962) 2 p
(FTD-TT-65-804/1+2+4; AD-624849) CFSTI: HC $1.00/MF $0.50

The object of the invention is a converter of electromagnetic waves into hypersonic waves designed in the form of a rectangular waveguide with a crystal of piezoquartz in the form of a parallelopiped and a wave of the type H_{10} which has the distinguishing feature that for the purpose of increasing the efficiency, on the area of the waveguide occupied by the crystal of piezoquartz there is located a retardation (inhibiting system) designed, for example in the form of a retardation comb the teeth of which are set perpendicular to the wide walls of the waveguide while the tips of the teeth reach to the surface of the crystal of piezoquartz, and the height of the teeth outside of the area of the location of the piezoquartz smoothly decreases down to zero. Author (TAB)

N66-17038# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
ON THE DEFINITION OF STATE IN QUANTUM STATISTICAL MECHANICS
Gérard G. Emch Nov. 1965 32 p refs
(Contract Nonr-595(22))
(BN-423; AD-624816) CFSTI: HC $2.00/MF $0.50

The controversy relative to the use of normal states in quantum physics is discussed in the light of ergodic theory. The nature of the spectrum of the Hamiltonian is shown to play a central role in the decision to enlarge the ordinary frame provided by the traditional density-matrix formalism. The connection of these considerations with the infinite-time, infinite-volume limits in non-equilibrium statistical mechanics is pointed out. Author (TAB)

N66-17067*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
A PROBLEM ON SUMMATION OVER HISTORIES IN QUANTUM MECHANICS
A. M. Arthurs 17 Jan. 1966 20 p refs
(Grant NsG-275, Contract DA-11-022-ORD-2059)
(NASA-CR-70312; WIS-TCI-144) CFSTI: HC $1.00/MF $0.50 CSCL 20J

The transition amplitude corresponding to a Dirac particle is evaluated as a sum over histories by a method based on unitary equivalence properties and the canonical formalism of quantum mechanics. Author

N66-17069*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
ON THE FACTORIZATION OF SECULAR EQUATIONS BY GROUP THEORY
W. Byers Brown 21 Jan. 1966 27 p refs Submitted for Publication
(Grant NsG-275)
(NASA-CR-70314; WIS-TCI-154) CFSTI: HC $2.00/MF $0.50 CSCL 20J

The factor equations are obtained in an explicitly invariant form which does not involve the matrix elements of degenerate irreducible representations of the group, but only the group characters. Author

N66-17083*# Florida Univ., Gainesville.
LINEAR ALGEBRA AND THE FUNDAMENTS OF QUANTUM THEORY
Per-Olov Löwdin 1 Jul. 1964 97 p refs Uppsala Univ. Quantum Chem. Group Tech. Note No. 125 *Its* Preprint No. 65
(Grant NsG-512)
(NASA-CR-70300; TN-125) CFSTI: HC $3.00/MF $0.75 CSCL 20J

It is investigated how far one can go in the formulation of the fundaments of quantum theory by using the axioms of linear algebra alone, i.e. without the help of the concept of the scalar product. In treating linear spaces of finite order, one can formulate the eigenvalue problem for a linear operator and reach the concepts of matrix representation, eigenexpansions, and transformation to diagonal and classical canonical form. One can further define the concepts of projection operators, the resolution of the identity, and the spectral resolution of an operator. In treating infinite spaces, the interest is confined to operators having all their eigenvalues situated in a finite number of points in the complex plane, each of which may be infinitely degenerate. Assuming that the operator under consideration satisfies a reduced Cayley-Hamilton equation of finite order, one shows that there exists a set of projection operators forming a resolution of the identity by means of which one can carry out a unique "component analysis" of an arbitrary element of the space. Even the spectral resolution of the operator exists. These theorems are inquantum theory of particular importance in treating constants of motion. In the last section, the scalar product is introduced, and the connection with the conventional approach is studied. Author

N66-17219*# California Inst. of Tech., Pasadena.
BINDING ENERGY AND STABILITY OF SPHERICALLY SYMMETRIC MASSES IN GENERAL RELATIVITY
James M. Bardeen [1965] 22 p refs Submitted for Publication
(Grant NGR-05-002-028; Contract Nonr-220(47))
(NASA-CR-60916) CFSTI: HC $1.00/MF $0.50 CSCL 20J

An analysis of non-adiabatic perturbations in a sequence of quasi-static general relativistic stellar models is used to prove that under certain assumptions about the entropy distribution a maximum or minimum in the binding energy implies some radial mode of oscillation is in neutral equilibrium. Also discussed is the derivation of a test for stability of radial modes of oscillation by considering virtual changes in the total energy under adiabatic perturbations. Author

N66-17227*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POLARIZATION OF THE INCIDENT BEAM IN NON-NORMAL REFLECTANCE MEASUREMENTS
John K. Coulter Sep. 1965 21 p refs
(NASA-TM-X-55369; X-713-65-353) CFSTI: HC $1.00/MF $0.50 CSCL 20F

In non-normal reflectance measurements on specular samples large errors can result if the polarization of the incident beam is not taken into account. This polarization can result from reflections off mirrors, refraction in prisms and windows, or from the light source itself. To compensate for the polarization it is not enough to know the intensity ratio of the two orthogonal components in the incident beam. However, correct results can be obtained by averaging the reflectance measurements in two orthogonal planes of incidence, without any knowledge of the amount of incident beam polarization. A simpler method, requiring only one measurement of reflected light, equalizes the two incident components by orienting a polarizing element normal to the beam, with its direction of maximum transmission at 45° to the plane of incidence of the sample. Results are given for aluminum at 75° angle of incidence which shows the agreement between the reflectance of a beam polarized at 45° and the reflectance of a completely unpolarized beam. A discussion of various polarizing elements is presented. Author

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24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N66-16191*# Arizona Univ., Tucson. Dept. of Physics.
MEAN LIVES OF SOME STATES IN ATOMIC HYDROGEN
A. S. Goodman and D. J. Donahue [1965] 20 p refs
(Grant NsG-628)
(NASA-CR-69896) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Hydrogen atoms in excited states were produced by passing a beam of fast-moving hydrogen molecules through a thin carbon foil. Radiation from these atoms was studied as a function of time using filtered photomultiplier tubes. Measured values of the mean lives of the 3s, 3d, 4s, 4p and 4d states in hydrogen are presented and compared with theory. Results of measurements of relative initial intensities of radiation from fine-structure states of the n = 3 and n = 4 levels in hydrogen are also presented. Author

N66-16337 Allahabad Univ. (India). Dept. of Physics.
NUCLEAR SPIN-LATTICE RELAXATION IN LIQUIDS
R. P. Gupta and P. K. Sharma *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 93-96 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Spin-lattice relaxation in liquids was analyzed through formation of a jump-diffusion model. It was assumed that a molecule in a liquid performs an oscillary motion about its equilibrium position for a certain interval and then jumps to a new position around which it again oscillates. Diffusion of molecules is achieved by a series of fast jumps. This theory was applied to the case of a water model and showed good agreement with experimental results. G.G.

N66-16344 Saha Inst. of Nuclear Physics, Calcutta (India).
NUCLEAR QUADRUPOLAR SHIELDING FACTORS FOR RARE EARTH IONS IN CRYSTALS
M. N. Ghatikar, A. K. Raychaudhuri, and D. K. Ray *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 131–136 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

The nuclear quadrupole shielding factors for Tm^{3+} and Pr^{3+} were obtained through a numerical method utilizing ionic wave functions to find the angular and radial excitations. Obtained R-factors for Tm^{3+} and Pr^{3+} showed large amounts of shielding. Since only ionic functions were applied, these values will change in the presence of a crystalline medium. G.G.

N66-16346 Saha Inst. of Nuclear Physics, Calcutta (India).
CALCULATION OF ELECTRONIC POLARIZABILITY AND SHIELDING FACTOR FOR ATOMS
J. Lahiri and A. Mukherji *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 144–151 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Described is a variation perturbation method which fully takes into account orbital couplings to estimate the induced electrical moment in an atom due to an external potential. The Hartree Fock Hamiltonian is applied to the case of an ion with n electrons where the perturbing field is produced by a distant charge along the positive axis of reference. Secular equations are used to trim the parameter matrix and to obtain a set of values for one perturbed orbital. The process is then iterated until all n sets are determined. About five iterations of this process bring the energy convergence below 10 ppm. Results for calculations on 2, 3, and 4 electron systems are presented graphically. G.G.

N66-16349 Saha Inst. of Nuclear Physics, Calcutta (India).
NUCLEAR MAGNETIC RESONANCE IN RARE-EARTH NITRATES, A COMPARISON WITH TRANSITION METAL NITRATES
Monisha Bose, Nikhilesh Chatterjee, and Nemai Das *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 162–170 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Nuclear magnetic resonances of N^{14} in paramagnetic nitrates were compared to those of transition metal nitrates with unpaired 3d electrons, and to rare-earth nitrates with unpaired 4f electrons in concentrated aqueous solutions. Transition metal nitrates of Fe, Co, Ni, and Cr exhibited no shift at all, whereas an 81 ppm positive shift for Cu and an extraordinarily large negative shift (−716 ppm) for Mn were observed. All the rare-earth nitrates investigated Pr (f^3), Nd (f^4), Sm (f^6), Gd (f^7), Tb (f^9), Dy (f^{10}) exhibited considerable shifts with line broadening to some extent. Shifts and line widths were concentration dependent and reverted to that of half normal diamagnetic nitrate in a dilute solution. Of intereste were negative shifts with half filled Mn(d^5) and Gd (f^7) shells. G.G.

N66-16359 Indian Inst. of Tech., Kanpur.
INELASTIC SCATTERING AND ELECTRON TEMPERATURE
V. V. Paranjape *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 229–232 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Electric field effects on the momentum distribution of electrons in semiconductors were studied by the hot electron theory. It was shown that under the action of an electric field and under suitable conditions the electron temperature T may decrease below T_o when the electric field is imposed. The electron temperature T was defined by expressing the distribution f(p) in the following form

$$f(\vec{p}) = A \exp - \left[\frac{(p-p_o)^2}{2mKT}\right]; \int f(\vec{p})\, d^3p = n$$

where p is the electron momentum, p_o the average electron momentum produced by the electric field, m the effective electron mass, K the Boltzmann's constant, A the normalizing factor, n the electron density, and T the electron temperature. It was assumed that the change in electronic energies was by fixed amount, and integral equations involving transition probabilities were formed in accordance with the conditions for conservation of energy and momentum. G.G.

N66-16415# European Atomic Energy Community, Brussels (Belgium).
IDENTIFICATION CHART FOR GAMMA EMITTING RADIONUCLIDES FORMED BY (n, γ) REACTIONS
F. Girardi, G. Guzzi, and J. Pauly Aug. 1965 18 p refs (EUR-2408.e) CFSTI: HC $1.00/MF $0.50

A chart for the identification of unknown gamma emitting radionuclides has been prepared. It gives the energy and the intensity of the main gamma peaks of those radioisotopes formed by (n, γ) reaction which are of interest in activation analysis. The nuclides considered have been represented in the order of half-life and in the alphabetic order of elements. The energy scale was chosen in such a way as to show the superimposition of gamma rays of slightly different energy in the same way as it appears on the oscilloscope of the multichannel analyzers. An effort has been made to reduce the size of the chart to make it easy to handle and to read. Author

N66-16457*# California Inst. of Tech., Pasadena.
NON-RESONANT NUCLEAR REACTIONS AT STELLAR TEMPERATURES
John N. Bahcall 21 Jun. 1965 10 p refs
(Contracts NGR-05-002-0028; Nonr-220(47))
(NASA-CR-69866) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A systematic and accurate procedure for calculating the rates of non-resonant nuclear reactions at stellar temperatures is described, and the approximations that are involved are indicated. The corrections needed, when using the present standard formulas are pointed out. L.S.

N66-16493# Syracuse Univ., N. Y. Dept. of Physics.
MESON RESONANCES
Jack Leitner [1965] 37 p refs Presented at the Symp. on Strong Interactions, Boulder, Colo., Aug. 1965 Prepared in Cooperation with Brookhaven Natl. Lab.
(Contract Nonr-66912)
(ONR-65-2; AD-473786)

Results concerning meson resonances are discussed, and information is given on (1) a nonstrange meson of mass ~1500 MeV; (2) some numbers concerning the decay modes of the X° and the ϕ, and (3) the conjectured κ meson. It is reported that the evidence comes from two sources: K^-p interactions at 4.6 and 5.0 BeV/c, and K^-p interactions at 2.24 BeV/c. M.G.J.

N66-16498# European Atomic Energy Community, Brussels (Belgium).
CALCULATION OF MULTIGROUP EXTRAPOLATION LENGTHS AND NEUTRON CAPTURE CYLINDERS SURROUNDED BY PREDOMINANTLY SCATTERING MEDIA WITH THE THRILL PROGRAM
C. Ponti Oct. 1965 33 p refs
(EUR-2536.e) CFSTI: HC $2.00/MF $0.50

The purpose of the THRILL code is the determination of some parameters which permit to deal with cylindrical absorbers surrounded by predominantly scattering media, in the frame of the diffusion theory: namely the code computes (a) the linear extrapolation length of the flux at the surface of the absorber, (b) fictitious diffusion parameters of the absorber, (c) blackness of the cylinder, (d) absorption rate per unit flux and area of the cylinder surface, and (e) ratio between the average flux inside the absorber and the surface flux. The absorber may contain two coaxial cylindrical regions, the inner may be absorbing and scattering, the outer only absorbing. The calculation is done in a multigroup scheme, and the results are then averaged for few groups, by means of the neutron spectrum calculated in the surrounding medium. Author

N66-16518# Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina).
PHENOMENOLOGICAL AND MICROSCOPIC ANALYSIS OF PROPERTIES OF EVEN-EVEN NUCLEI. PART B: COLLECTIVE BEHAVIOR FROM PARTICLE DYNAMICS
C. A. Heras (La Plata Univ.), S. M. Abecasis, and H. E. Bosch Jun. 1965 77 p refs
(Contract DA-ARO-49-092-65-G78)
(LR-8; AD-624028) CFSTI: HC $3.00/MF $0.75

A widening of the applicability of phenomenological models is accompanied by an increase in the number of parameters needed. More fundamental models are then required in order to explain the growing wealth of experimental data. Such models might be classified as semi-phenomenological to distinguish them from more rigorous ones. In addition some attempts to obtain collective coordinates from the particle ones will be briefly described. The aim of these attempts is to provide a foundation both to phenomenological and semiphenomenological models. The large quadrupole moments observed in nuclei with many nucleons outside closed shells have for long been associated with nonspherical mass of distributions. Since the common field in which the nucleons move in an independent particle model is built self-consistently from a short-range nucleon-nucleon interaction, A non-spherical mass distribution would imply a non-spherical single-particle potential. In actual calculations a common potential of prescribed form is used, generally a harmonic oscillator one. Of course, this potential is probably not more than a good starting approximation to the self-consistent field but this is far more difficult to handle. TAB

N66-16568 United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center.
GAMMA SPECTRAL DATA FOR SHIELDING AND HEATING CALCULATIONS
J. Celnik and D. Spielberg 30 Nov. 1965 70 p refs
(Contract NAS3-2600; UNC Proj. 2326)
(NASA-CR-54794; UNC-5140) CFSTI: HC $3.00/MF $0.75
CSCL 20H

Spectra of gamma rays following neutron absorption and inelastic-scattering events in H, Be, C, O, Al, Cr, Fe, Ni, Zr, natural W and the W isotopes, U^{235} and U^{238} are tabulated. The gamma thermal capture spectra for Cd and Sm are presented. A detailed study of the prompt and delayed fission gammas (both intensities and time variations) is also given. Descriptions are given of the sources of information and the calculations performed. In addition, an evaluation of the reliability of the data is given. Author

N66-16689# Uppsala Univ. (Sweden). Quantum Chemistry Group.
THE INDEPENDENT PARTICLE MODEL FOR MANY-ELECTRON SYSTEM. II: SYMMETRY PROPERTIES AND CRITERIA FOR THE VALIDITY OF THE INDEPENDENT PARTICLE MODEL
Werner Kutzelnigg and Vedewe H. Smith, Jr. 1 Nov. 1964 38 p refs *Its* Preprint No. 138
(Contract AF 61(052)-701)
(SR-33; ARL-65-250; AD-625213) CFSTI: HC $2.00/MF $0.50

Contents: symmetry and orthogonality properties of the orbitals (symmetry of the 'best density' approximation, definition and properties of 'open' and 'closed shell' states, the principle of doubly filled orbitals and its limitations, symmetry of the 'best energy' approximation, symmetry of the 'best overlap' approximation); conditions for the validity of the independent particle model (comparison with the true first order density matrix, overlap with the true wave function, the independent particle model for closed and open shell states); on localized orbitals (localizability and independence of quantum mechanical systems, definition of 'localized orbitals'). TAB

N66-16690# Uppsala Univ. (Sweden). Quantum Chemistry Group.
STUDIES IN PERTURBATION THEORY. XI: LOWER BOUNDS TO ENERGY EIGENVALUES, GROUND STATE AND EXCITED STATES
Per-Olov Löwdin 15 Jun. 1965 47 p refs *Its* Preprint No. 121
(Contract AF 61(052)-701)
(SR-16; ARL-65-248; AD-625364) CFSTI: HC $2.00/MF $0.50

The bracketing theorem in the partitioning technique for solving the Schrodinger equation may be used in principle to determine upper and lower bounds to energy eigenvalues. Practical lower bounds of any accuracy desired may be evaluated by utilizing the properties of 'inner projections' on finite manifolds in the Hilbert space. The method is applied to the ground state and excited states of a Hamiltonian having a positive definite perturbation V. Even if inspiration is derived from the method of intermediate Hamiltonians, the final results are of bracketing type and independent of this approach. The method is numerically illustrated in some accompanying papers. Author (TAB)

N66-16698*# National Bureau of Standards, Washington, D. C.
AN ELECTRONIC QUADRUPOLE TRANSITION IN THE $A^1\Pi \leftarrow X^1\Sigma^+$ SYSTEM OF CO
S. G. Tilford and J. D. Simmons 30 Nov. 1965 20 p refs
(NASA Order R-64)
(NASA-CR-70045; NBS-9008) CFSTI: HC $1.00/MF $0.50
CSCL 20H

In the fourth positive system, $A^1\Pi \leftarrow X^1\Sigma^+$, of CO electric quadrupole transitions ($\Delta J = 2$) have been observed for the first time in bands of an electric dipole *allowed* transition. The quadrupole transition probability has been determined to be $\sim 1.1 \times 10^3$ sec^{-1}. This value compares well with the value of $\sim 2.0 \times 10^3$ sec^{-1} determined for the quadrupole transition probability of the electric dipole *forbidden* a $^1\Pi_g \leftarrow X^1\Sigma_g^+$ transition in the isoelectronic N_2 molecule. Author

N66-16700*# Arizona Univ., Tucson. Graduate Coll.
A MEASUREMENT OF LIFETIMES OF EXCITED STATES OF IONIZED NITROGEN ATOMS
Gary Neal McIntire (M.S. Thesis) [1966] 50 p refs (Grant NsG-628)
(NASA-CR-70042) CFSTI: HC $2.00/MF $0.50 CSCL 20H

A beam of diatomic nitrogen ions, transmitted through a thin carbon foil, produced optical spectra of singly and doubly ionized nitrogen atoms as a result of collisions in the foil. Photographs of the resolved spectrum of this ionized nitrogen beam were examined. Since the beam particles were monoenergetic, an analysis of the decay in intensity of the individual spectral lines yielded the mean lifetimes of the emitting energy levels. The measurement of this variation in intensity along a spectral line was accomplished by microphotometric techniques. It was found that some of the excited states of singly and doubly ionized nitrogen have mean lifetimes of the order of 10^{-8} seconds. Author

N66-16702*# Arizona Univ., Tucson. Graduate Coll.
WAVELENGTHS OF ELECTRONIC TRANSITIONS IN FOIL-EXCITED BEAMS OF LIGHT ELEMENTS
David Fink (M.S. Thesis) [1966] 68 p refs
(Grant NsG-628)
(NASA-CR-70036) CFSTI: HC $3.00/MF $0.75 CSCL 20H

Resolved spectral lines from deuterium, carbon, nitrogen, and oxygen were recorded on photographic plates. In each case, the source of the light was a beam of particles which, following acceleration in a Van de Graaff generator, passed through a thin carbon foil. Comparison spectra, from a standard iron-neon lamp, were also recorded on each plate. The plates were used to measure the wavelengths of the spectral lines characteristic of the radiating beams, and to identify the transitions responsible for those lines. The wavelengths of 109 spectral lines were measured, the transitions responsible for 26 spectral lines were identified, and possible transitions for 54 others were specified. Author

N66-16780# European Atomic Energy Community, Brussels (Belgium).
A PROGRAMME FOR THE SOLUTION OF THE MONOENERGETICAL TRANSPORT EQUATION IN THE P5 APPROXIMATION FOR A MULTIREGION CYLINDRICAL GEOMETRY
L. Massimo Nov. 1965 44 p refs
(EUR-2584.e) CFSTI: HC $2.00/MF $0.50

The report describes a Fortran II code for the IBM 7090 computer which solves the monoenergetical transport equation in the P5 approximation for a multiregion cylindrical geometry. Special attention is paid to the numerical difficulties encountered in this work. Author

N66-16894 Argonne National Lab., Ill.
THE ARGONNE NATIONAL LABORATORY'S PION FOCUSING HORN
Herbert F. Vogel, W. Brunk, E. Roberts, H. Hinterberger, V. L. Telegdi et al (Chicago Univ.) *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 650–656 refs (See N66-16826 07-23) CFSTI: $8.50

A pion focusing device has been built for high energy neutrino experiments increasing the event rate by about one order of magnitude. The horn is cylindrically symmetric, and consists of a thin-walled conical inner conductor, and of a cylindrical outer (return) conductor both conducting a pulsed current of ~ 300 kA. The azimuthal magnetic field between these conductors focuses particles (of one sign) produced in a target (Be) 60 cm long, 3 cm diameter. The tubular extension, in which it is mounted, is conical with the narrow end at the apex of the inner conductor. This is done by a series of concentrically mounted, toroidally wound iron cores pulsed from a 110-kilojoule, 30 kV capacitor bank. The characteristics of the discharge circuit are such that >91% of the peak current is maintained during 1 millisecond at 20 ppm. The magneto-optical design of the device and its electrical, thermal and mechanical properties are described. Author

N66-16916# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ROTATIONAL ENERGY LEVELS OF ASYMMETRIC TOP MOLECULES. PART III: TABLE OF REDUCED ENERGIES FOR J = 6 TO 9
M. Sidran, F. Nolan, and J. W. Blaker Jun. 1963 164 p refs (RE-155)

The tables of reduced energies for asymmetric top molecules for J = 6 to 9 and intervals of 0.001 in kappa are presented. Corresponding tables for lower J values are available in a separate volume. The computation was performed in single precision on the IBM 7094 using a method due to Givens. All eigenvalues refer to the ground vibration state and assume no centrifugal distortion. The 2 J + 1 eigenvalues for a given J are the roots of a secular determinant of degree 2 J + 1 obtained by the application of group theory to the symmetry properties of the molecule. E.E.B.

N66-16957# United Kingdom Atomic Energy Authority, Culham (England).
CROSS SECTIONS FOR COLLISIONS OF ELECTRONS WITH HYDROGEN ATOMS AND HYDROGEN-LIKE IONS
I. C. Percival Aug. 1965 20 p refs Submitted for Publication (CLM-P-87)

On the basis of a limited critical review of present theory and experiment, cross sections are recommended for the ionization of any level of hydrogen or any hydrogenic ion by electrons, for the excitation of any level from the ground level, and $n \rightarrow n + 1$ excitation from higher levels. Individual angular momentum and Stark states of the levels are not considered. Author

N66-16982*# Florida Univ., Gainesville.
STUDIES IN PERTURBATION THEORY. XI: LOWER BOUNDS TO ENERGY EIGENVALUES, GROUND STATE AND EXCITED STATES
Per-Olov Lowdin 15 Jun. 1964 51 p refs Uppsala Univ. Quantum Chem. Group Tech. Note 121 *Its* Preprint No. 68
(Grant NsG-512)
(NASA-CR-70210; TN-121) CFSTI: HC $3.00/MF $0.50 CSCL 20H

The bracketing theorem in the partitioning technique for solving the Schroedinger equation may be used in principle to determine upper and lower bounds to energy eigenvalues. Practical lower bounds of any accuracy desired may be evaluated by utilizing the properties of inner projections on finite manifolds in the Hilbert space. The method is here applied to the ground state and excited states of a Hamiltonian $H = H_0 + V$ having a positive definite perturbation V. Even if inspiration is derived from the method of intermediate Hamiltonians, the final results are of bracketing type and independent of this approach. The method is numerically illustrated in some accompanying papers. Author

N66-17010# Stanford Univ., Calif. High-Energy Physics Lab.
STUDY OF NUCLEAR EXCITATIONS IN B^{10}, B^{11}, AND N^{14} BY INELASTIC ELECTRON SCATTERING AT 180°

P. Kossanyi-Demay and G. J. Vanpraet Oct. 1965 30 p refs Submitted for Publication
(Contract Nonr-225(67))
(HEPL-391; AD-624270) CFSTI: HC $2.00/MF $0.50

A study is made of nuclear energy states in B^{10}, B^{11}, and N^{14} by means of inelastic electron scattering at 180 deg. Radiation widths were derived for the excited states and the results are compared with the single particle model predictions. For the magnetic dipole transitions in B^{10} and B^{11} a comparison is made of the experimental data with recently calculated M1 transition strengths in p-shell nuclei by Cohen and Kurath. Author (TAB)

N66-17015# Stanford Univ., Calif. High Energy Physics Lab.
BEAM INSTABILITIES IN THE PRINCETON-STANFORD STORAGE RINGS
W. C. Barber, B. Gittelman, G. K. O'Neill (Princeton Univ.), and B. Richter Sep. 1965 21 p refs Presented at V Intern. Conf. on High Energy Accelerators, Frascati, Italy, 9–16 Sep. 1965
(Contracts Nonr-225(67); Nonr-1858(39); AT(04-3)-515) (HEPL-406; AD-624271) CFSTI: HC $1.00/MF $0.50

The most salient features of the beam instabilities in the Princeton–Stanford storage rings are summarized. The phenomena are classified into three groups: (1) vertical instabilities of a single beam; (2) vertical instabilities associated with the interaction between two beams; (3) changes in radial and azimuthal size of single beam. TAB

N66-17068*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
ON THE ELECTRONIC ENERGY OF A ONE-ELECTRON DIATOMIC MOLECULE NEAR THE UNITED ATOM
W. Byers Brown and Erich Steiner (Exeter Univ.) 18 Jan. 1966 35 p refs
(Grant NsG-275)
(NASA-CR-70313; WIS-TCI-151) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The behavior of the electronic energy for the ground state of a one-electron heteronuclear diatomic molecule in the vicinity of the united atom is obtained through terms of order R^5 in the internuclear distance R. The presence of a term in $R^5 \log R$ reveals that the electronic energy is not an analytic function of R at the united atom. The expansion is checked by means of the Hellmann–Feynman theorem and the work of Dalgarno and Lynn. Author

N66-17084*# Florida Univ., Gainesville.
QUANTUM THEORY OF TIME-DEPENDENT PHENOMENA TREATED BY THE EVOLUTION OPERATOR TECHNIQUE
Per-Olov Löwdin 15 Jun. 1965 83 p refs Uppsala Univ. Quantum Chem. Group Tech. Note No. 100 *Its* Preprint No. 78
(Grant NsG-512)
(NASA-CR-70301; TN-100) CFSTI: HC $3.00/MF $0.50 CSCL 20J

A brief discussion is presented of the treatment of time dependent phenomena in the nonrelativistic quantum theory. Consideration is given to such areas as the coordinate and momentum space, the Schrodinger equation, the Schrodinger equation for particles in an electromagnetic field, the evolution operator, the reformulation of quantum theory, transition probabilities, and the time dependent perturbation theory. Included are discussions of specific applications and agreement with experimental results for such equations as the complex wave function, and the evolution and differential operators. C.T.C.

N66-17106# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Physics.
HARTREE-FOCK CALCULATIONS OF FINITE NUCLEI
R. Muthukrishnan (Ph.D. Thesis) Sep. 1965 123 p refs
(Contract Nonr-760(15))
(TR-19; AD-624314) CFSTI: HC $4.00/MF $0.75

A matrix formulation of the Hartree-Fock method is used to calculate properties of finite nuclei. The two-body interaction used is of the non-local separable type, which gives saturation. The S-wave interaction is chosen such as to give the energy and density of nuclear matter correctly and have small second-order corrections. Calculations are done for nuclei C^{12}, O^{16}, Si^{28}, Ca^{40}, Zn^{60}, and Zr^{80} with the S-wave force. The single particle energies and wave functions are obtained. Since only the S-wave force is included there is no spin-orbit splitting of the single particle levels. The closed shell nuclei O^{16}, Ca^{40}, and Zr^{80} are more bound than the non-closed shell nuclei C^{12}, Si^{28}, and Zn^{60}. Calculations for C^{12} and Si^{28} are done with pure anisotropic harmonic oscillator functions as the wave functions and these nuclei prefer a deformed shape over spherical shape. The single particle levels are much deeper than what would be expected from a local single particle potential. This shows the strong non-locality of the single-particle potential. The properties of O^{16} and Ca^{40} are calculated with forces acting in both relative S and P states. Author

N66-17113# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
QUASI-FREE PROTON-PROTON SCATTERING IN LIGHT NUCLEI AT 460 MeV
H. Tyren, S. Kullander, O. Sundberg, R. Ramachandran, P. Isacsson et al [1965] 152 p refs
(Grant AF-AFOSR-18-64)
(AFOSR-65-1678; AD-624318) CFSTI: HC $4.00/MF $1.00

Quasi-free proton-proton scattering was studied in a number of light nuclei at 460 MeV using two large identical magnetic spectrometers with two-directional focusing and a multichannel electronic detector system. The experiments are done in a symmetric geometry. Summed energy spectra and angular correlation distributions of separated components of the spectra are presented. The experimental results for the lighter nuclei are analyzed by comparing them with theoretical ones obtained on the basis of the distorted wave impulse approximation. Information on the radii and occupation numbers of the 1s and 1p orbitals in the nuclei considered is obtained. Author (TAB)

N66-17167# California Inst. of Tech., Pasadena.
DISTRIBUTION OF LEPTON PAIRS FROM VECTOR MESON DECAYS
Douglas S. Beder Jun. 1965 26 p refs
(Contract AT(11-1)-68)
(CALT-68-43) CFSTI: HC $2.00/MF $0.50

Expressions are derived for the differential cross section for lepton pair production resulting from decay of a vector meson. The vector meson is assumed to originate in a reaction of the type pseudoscalar meson+baryon $\rightarrow$vector meson+baryon. The particular reactions considered are $\pi^- + p \rightarrow \rho^0 + n$ or $\rightarrow \omega^0 + n$. The pure peripheral model is used to discuss the lepton differential cross section, assuming that either PS or V exchange dominates the production amplitude and employing Feynman diagrams. The angular distribution of the decay leptons is obtained in terms of the V production density matrix and the $V \rightarrow e^+e^-$ amplitudes. The predictions for the angular distribution based on experimental analysis of ρ and ω production are discussed. Current ideas about decay widths into lepton pairs of the known V mesons are briefly reviewed. NSA

N66-17181# Columbia Univ., Irvington, N. Y. Nevis Lab.
A MEASUREMENT OF THE K^0 MASS AND THE K^0-K^- MASS DIFFERENCE
J. K. Kim, L. Kirsch, and D. Miller Jul. 1965 13 p refs
(Contract AT(30-1)-1932)
(NEVIS-141; R-513; CU-1932-247) CFSTI: HC $1.00/MF $0.50

From the decay of the K_1^0 in a hydrogen bubble chamber, the mass of the K^0 was measured to be 497.44 ±0.33 Mev. From the interaction

$$K^-p \rightarrow K^0n \quad (K^0 \rightarrow \pi^+\pi^-)$$

the K^0-K^- mass difference was measured to be 3.71 ±0.35 Mev. Author (NSA)

N66-17183# Aktiebolaget Atomenergi, Stockholm (Sweden).
AN ELECTROMAGNET FOR PRECESSION OF THE POLARIZATION OF FAST-NEUTRONS
O. Aspelund, J. Bjoerkman, and G. Trumpy May 1965 29 p refs
(AE-189) CFSTI: HC $2.00/MF $0.50

The advantages of using a transverse magnetic field for precessing the polarization of fast neutrons are discussed. Design details of a powerful electromagnet supplying a transverse field of approximately 20 kG are given. Precession characteristics for polarized fast neutrons obtained at 50° (lab) from the $^7Li(p,n)^7Be$ reaction are reported, using elastic scattering at 42° (lab) off natural carbon as an analyzer. Correlation of the precession data with theoretical predictions presented elsewhere is made, and good agreement is found. Author (NSA)

N66-17184# Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.
MOSSBAUER EFFECT STUDIES WITH ACTINIDES
J. A. Stone 7 Apr. 1965 34 p refs Presented at the Panel on the Uses of the Mossbauer Effect in Chem. and Solid State Phys., Vienna, 26–30 Apr. 1965; Sponsored by Intern. Atomic Energy Agency
(Contract AT(07-2)-1)
(Conf-650425-1) CFSTI: HC $2.00/MF $0.50

The Mossbauer effect is expected to become a valuable tool for studying properties of the actinide elements. Numerous gamma transitions in actinide isotopes appear to be suitable for nuclear resonance absorption, and a compilation of these is given. The 59.6-kev gamma ray in ^{237}Np has been demonstrated to give the Mossbauer effect, following both beta- and alpha-decay; the current experimental and theoretical situation with this isotope is reviewed. A search is underway for narrow, single emission and absorption lines for use as probes of hyperfine structure. Future possibilities for work with ^{237}Np are discussed; nuclear moments of ^{237}Np, chemical bonding and magnetic properties of Np compounds, lattice dynamics, and radiation damage are some of the areas where new information may be obtained. Author (NSA)

N66-17185# Maryland Univ., College Park. Dept. of Physics and Astronomy.
K_{e3}^- INTERACTIONS AT 940 Mev/C AND THEIR BEARING ON Y* (1765)
G. B. Yodh May 1965 34 p refs
(Contract AT (40-1)-2504)
(CONF-650410-2) CFSTI: HC $2.00/MF $0.50

Data are presented from the following momenta: 900, 922, 940, 960, and 985 Mev/c. The experimental technique involved and the bearing of the results on the Y* (1765) are discussed. A discussion of the decay channels $\Lambda\pi^0$, $\bar{K}n$, $\Lambda\pi^+\pi^-$ is included. Total cross sections are presented. NSA

N66-17190* National Aeronautics and Space Administration, Washington, D. C.
ON THE RELATION BETWEEN THE MAGNITUDE OF AN IONIZATION BURST AND THE SIZE OF A SHOWER IN HIGH-PRESSURE CHAMBERS
D. D. Krasil'nikov *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 14–19 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

An analysis of the lead–iron and iron–argon transition effects from ionization bursts in large C-type high-pressure chambers was performed in order to establish the relationship between the magnitude of a burst and the size of the cascade shower. No allowance was made for scattering of shower particles and ion recombination effects. It was concluded that the walls of the chamber absorbed about 50% of the shower particles at a thickness of $t_{Fe} = 1.59$. The iron–argon transition effect corresponded to about 10% to 20% reduction of the ionization due to shower particles. G.G.

N66-17242*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
EXCITATION OF H-ATOMS BY FAST PROTONS
Ian M. Cheshire and H. Lee Kyle Dec. 1965 10 p refs
(NASA-TM-X-55410; X-641-65-505) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A simple formula for the total Born cross section for the excitation of ground state H-atoms to any excited state n is given and a table of cross sections is included for representative n and impact energies. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N66-16198# Harvard Univ., Cambridge, Mass. Cruft Lab.
RADIATION FROM A CURRENT LOOP IN A COMPRESSIBLE PLASMA Interim Technical Report
H. S. Tuan 25 Jun. 1965 24 p refs
(Contract Nonr-1866(32))
(TR-475; AD-624154) CFSTI: HC $1.00/MF $0.50

The technique of treating radiation problems in two-component, warm isotropic plasmas in terms of three orthogonal modes is applied to investigate the radiation characteristics of a circular filamentary current loop with a prescribed current distribution. The cases of a circular loop excited with dipole-mode current at frequencies below the ion plasma frequency is emphasized. Numerical values for the radiated power are obtained for certain interesting ranges of the parameters. Author (TAB)

N66-16250*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.

ELECTRODE CURRENT DISTRIBUTIONS IN MGD CHANNELS

Myron A. Hoffman and Gordon C. Oates Jan. 1966 45 p refs (Grant NsG-496)

(NASA-CR-69996; CSR-TR-66-1) CFSTI: HC $2.00/MF $0.50 CSCL 20I

Experimental and theoretical investigations have been made of the current distributions to continuous and segmented electrodes in linear MGD channels. The electrodes were subdivided to obtain a measure of the current distribution for various average current densities up to 0.7 amps/cm^2 and Hall parameters up to 5. Current concentrations were measured at the edges of electrodes. However, the concentrations were less pronounced than those predicted by theories in which constant electrode potential and uniform gas properties are assumed. The experimental results are compared to the predictions of a semiempirical theory that includes a current density dependent electrode potential. The agreement between experiment and theory in this case is more satisfactory. It is concluded that electrode and sheath voltage drops tend to limit current concentrations on the electrodes at least in the current density and Hall parameter regime. Author

N66-16285*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

BASIC STUDIES OF A LOW DENSITY HALL CURRENT ION ACCELERATOR

Donald L. Chubb and George R. Seikel Washington, NASA, Feb. 1966 57 p refs

(NASA-TN-D-3250) CFSTI: HC $3.00/MF $0.50 CSCL 20G

An experimental and theoretical investigation of a low density annular Hall current ion accelerator operating with argon gas was carried out. The variation of electron temperature and number density, ion current density, and plasma potential through the accelerator were experimentally determined as a function of the magnetic field strength. Azimuthal electron Hall current was also measured. Experimentally determined values of the axial electron current density parallel to the applied electric field were much larger than those predicted by classical electron diffusion, and the ratio of the azimuthal Hall current to the axial current was much smaller than expected. As a result, it was concluded that an anomalous electron diffusion mechanism exists. The variation of the electric field with magnetic field could be reasonably predicted by an anomalous electron diffusion analysis that made use of the experimentally determined value of the Hall parameter (electron cyclotron frequency/electron collision frequency). The experimental results indicate that energy and momentum transfer to the accelerator walls are the primary loss mechanisms for the accelerator. Author

N66-16309# General Electric Co., Philadelphia, Pa. Missile and Space Div.

MEASUREMENT OF PLASMA DENSITIES BY VACUUM ULTRAVIOLET ABSORPTION SPECTROSCOPY

P. Gloersen and S. F. Collins Nov. 1965 18 p refs *Its* Tech. Inform. Ser.

(R65SD29; AD-623971) CFSTI: HC $1.00/MF $0.50

Plasma densities are usually measured by determining the electron densities by a variety of techniques. Under certain circumstances, it is desirable also to know the identities of the associated ions as well as their densities and location relative to the electrons and to know what and how many neutral atoms and molecules are present. A straightforward means of accomplishing this, at least qualitatively, is through vacuum ultraviolet absorption spectroscopy, since most ions, atoms, and molecules have their resonance absorption spectrum lines in this region. Quantitative measurements require the knowledge of oscillator strengths and line shapes for the respective resonance lines. Such knowledge is by no means complete, but enough information is available to make this technique a useful one. The general considerations in applying this technique are discussed, along with a a numerical example using the 1470A resonance line of xenon. Author (TAB)

N66-16407*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

ADDITIONAL STUDY AND FURTHER DEVELOPMENT OF THE TRACER-SPARK TECHNIQUE FOR FLOW-VELOCITY MEASUREMENTS Third Semiannual Progress Report

James B. Kyser Dec. 1965 61 p refs

(Grant NsG-620)

(NASA-CR-69817) CFSTI: HC $3.00/MF $0.75 CSCL 20I

A study of the behavior of a spark-heated column of gas in a hypersonic stream is described, as well as time-resolved measurements of spark temperature and intensity profile in a static test chamber for a range of spark energies and static pressures. In addition, the effects of a magnetic field parallel to the spark axis were investigated. On the basis of these static measurements, electric field strength, electron energy, and ionization level were computed. The results show that a low voltage gradient and a low electron temperature exist in the spark at its mid-duration. Ionization level is high, particularly in the case of high magnetic field strength and low static pressure. Assuming that the initial conditions for the spark-heated column are given by the average conditions during the spark lifetime, the starting point in the study of the spark-heated column behavior were established. A spark process analysis indicates that the rate of increase of translational–rotational temperature has a maximum value at an electric field strength of 1.0 to 1.5 volts/cm/mm Hg, and is rather insensitive to changes in field strength. Also, the maximum computed value is only about 60% of the measured rate of increase of temperature. A preliminary analysis showed that rotational nonequilibrium effects could be responsible for this discrepancy. R.R.D.

N66-16408*# Harvard Coll. Observatory, Cambridge, Mass.

LINE-REVERSAL MEASUREMENTS OF EXCITATION AND ELECTRON TEMPERATURE IN A SHOCK TUBE

W. R. S. Garton (Imperial Coll.), W. H. Parkinson, and E. M. Reeves Nov. 1965 12 p refs *Its* Sci. Rept.-8

(Grant NsG-438; Contract Nonr-1866(48))

(NASA-CR-69818) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The spectral line-reversal method has been applied to determine population-temperatures within an (argon–calcium) plasma, generated by a reflected aerodynamic shock. The measurements have been made simultaneously on (a) normal bound-bound Ca I lines, (b) lines involving strongly autoionizing levels. The agreement of the two sets of values identifies the electron-temperature with the temperature characterizing the populations of the bound excited-states, giving improved confidence in the existence of complete thermal equilibrium in the reflected shock. Author

N66-16409*# AVCO-Everett Research Lab., Everett, Mass.

THE DIOCOTRON INSTABILITY IN A QUASI-TOROIDAL GEOMETRY

R. H. Levy and J. D. Callen Sep. 1965 26 p refs
(Contract NASw-1101)
(NASA-CR-69815; AVCO-Everett Res. Rept.-228) CFSTI: HC $2.00/MF $0.50 CSCL 20I

The diocotron (or slipping stream) instability of low density ($\omega_p << \omega_c$) electron beams in crossed electric and magnetic fields is considered for a cylindrical geometry with a radial electric field and an azimuthal magnetic field. In the analysis the electrons are assumed to have no thermal energy, collisional effects are neglected, the quasi-static approximation is made, and perturbations of the electric field along the magnetic field are ignored. For a simple density distribution the important normal modes of the electron beam correspond to two discrete eigenvalues. A condition for the stability of these modes is derived. This condition shows that, within the approximations of the analysis, the electron beam can be stabilized against diocotron modes of all wavelengths by proper selection of dimensions. The application of this theory to a proposed toroidally-shaped space radiation shield is discussed. Assuming the long straight cylinder geometry to be a reasonable approximation to a torus with a large radius ratio, it is shown that the crossed field electron beam surrounding a pace radiation shield will, within the same approximations, be stable against diocotron instabilities when the beam is sufficiently thick. Author

N66-16502# Rochester Univ., N. Y. Dept. of Mechanical and Aerospace Sciences.
PLASMA DENSITY AHEAD OF PRESSURE DRIVEN SHOCK WAVES
Lawrence Bruce Holmes (Ph.D. Thesis) May 1965 200 p refs *Its* Tech. Note No. 1
(Grant AF-AFOSR-478-65)
(AFOSR-65-0974; AD-622569) CFSTI: HC $5.00/MF $1.25

A review of the literature on electrical precursors associated with strong shock waves is presented. Negative well-type electrostatic precursor signals are obtained from the potential probe experiments. Potential probe experiments in conjunction with a solenoidal magnetic field show that the electrostatic precursor signal is due in part to radial diffusion of electrons to the wall of the shock tube. A theory is presented for the diffusion of the electrons and ions to the grid of the probe and for the motion of the charged particles inside the probe. This theory relates the collected currents to the plasma density in the shock tube. The evidence of the existence of a neutral plasma and the high velocity of propagation of the precursor strongly suggests that the gas ahead of the shock wave is photoionized. It was established that multiple step photoionization produces the plasma. TAB

N66-16554*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ERROR IN INDUCED ELECTRIC FIELD MODES UNDER STIX COIL RESULTING FROM ASSUMPTION OF ORTHOGONALITY OF NATURAL PLASMA MODES
Richard R. Woollett Washington, NASA, Feb. 1966 31 p refs
(NASA-TN-D-3255) CFSTI: HC $2.00/MF $0.50 CSCL 20I

When the Bessel function representing the induced electric field in a plasma under a Stix coil is expanded in terms of the natural plasma modes, the coefficients of the expansion may be approximated by assuming that the eigenfunctions are orthogonal. However, the eigenfunctions are not orthogonal. When the orthogonality assumption is not used, there results an infinite system of equations involving an infinite set of unknowns. Kantorovich developed a technique that can be adapted to this problem. The technique produces both a deficient and an excessive value of the coefficient. Because the correct value lies between these two limits, the greatest error resulting from the orthogonality assumption can be obtained. In the cases tested it was found that the errors involved in determining the coefficients using the orthogonality assumption were less than 0.1 percent for the fundamental mode. Author

N66-16582# General Electric Co., Philadelphia, Pa. Missile and Space Div.
CONCERNING THE APPLICATION OF ELECTRON BEAMS TO MHD POWER GENERATION
H. E. Hall and F. H. Shair Aug. 1965 68 p refs
(R65SD40)

A brief review is given over the methods used in computing supersonic ejector nozzles with low and high secondary mass flow rates. Empirical data are given for demonstrating the excellent agreement for cases in which the fluid used for the primary and secondary streams is air at ambient temperature. For the case of a real air exit (variable γ and temperature), a critical review over the theory demonstrates that the influence of these factors is taken into consideration in cases of high mass flow rate. Author

N66-16598*# Rensselaer Polytechnic Inst., Troy, N. Y. Plasma Research Lab.
CHARACTERISTICS OF MAGNETOPLASMAS Semi-annual Status Report No. 12, May 1–Oct. 31, 1965
E. H. Holt, H. B. Hollinger, D. A. Huchital, P. Blaszuk, and P. N. Y. Pan Dec. 1965 27 p refs
(Grant NsG-48)
(NASA-CR-70151) CFSTI: HC $2.00/MF $0.50 CSCL 20I

Emphasis was on the study of the Kadomtsev instability which pertains to the behavior of a collision dominated plasma in a magnetic field. Work on this instability in the positive column of an electrical discharge in helium has extended previous results to include the effect of a transverse component of the magnetic field. The Kadomtsev theory was successfully modified to account for the major features of the experimental results. A further aspect of plasma transport phenomena was studied. This concerns the initial value aspects of the conduction of heat in a plasma and follows the previous studies dealing with plasma diffusion from this point of view. A study of the non-Maxwellian form of the electron velocity distribution function in the nitrogen afterglow plasma is reported. This work was done by combining the use of the magnetoplasma waveguide cell with the gated microwave radiometer. The major features of the distribution function in the early afterglow were revealed. The apparently anomalous behavior of the electron gas in the nitrogen afterglow was explained. Design, construction, and the taking of preliminary performance data for various parts of the cesium plasma cell has proceeded. The filament and hot plate structures have been constructed and operated. The design of the probes and the cesium ovens and details of the complete assembly are described. Author

N66-16619# Wayne State Univ., Detroit, Mich.
STUDIES OF THE DYNAMO ACTION OF THE LIQUID CORE OF THE EARTH Final Report, Jan. 1963–Aug. 1965
A. F. Stevenson 16 Aug. 1965 56 p refs
(Contract AF 19(628)-2497)
(AFCRL-65-609; AD-625457) CFSTI: HC $3.00/MF $0.50

The differential equations for the steady motion of a rotating conducting fluid interacting with a magnetic field, and 'driven' by a volume distribution of thermal sources, have been

set up. They contain two dimensionless parameters, one of which is proportional to the joule heating and the other to the difference between the temperature gradient maintained by the thermal sources and the adiabatic temperature gradient. The problem is reduced to solving an infinite set of quadratic equations, and all necessary numerical calculations of the integrals involved have been carried out. The infinite set of equations can be approximated by finite sets, and properties of these sets have been investigated in detail. It has been shown that the two parameters of the problem must be related. Simple solutions of finite sets have been obtained, and a great deal of I.B.M. 7070 computer time has been devoted to attempts to generalize these solutions, but without success. The existence of a steady state dynamo has not been proved or disproved. The work reported should be of value to anyone undertaking similar calculations in the future. Author (TAB)

N66-16621# Hughes Research Labs., Malibu, Calif.
THE CESIUM IONIZATION CROSS SECTION FROM THRESHOLD 50 eV Scientific Report No. 1
H. Heil and B. Scott Nov. 1965 27 p refs Submitted for Publication
(Contract AF 19(628)-4297)
(AFCRL-65-815; AD-625451) CFSTI: HC $2.00/MF $0.50

The ionization cross section sigma which was recently measured by Brink at 50 eV and above has been measured down to threshold in a Tate and Smith type apparatus designed for absolute measurements. The density in the collision space was determined by a surface ionization detector which permitted an over-all accuracy on the cross section of 10 percent. It was found: (1) $\sigma = 5.3\text{Å}^2$ at 50 eV. This is smaller by a factor of 1.8 than the above experiment and the theoretical values of the Gryzinski method—the discrepancy has not been explained. (2) The cross section near threshold is linear over a range of 0.8 eV with a slope of $2.2\text{Å}^2\text{eV}^{-1}$. Above 0.8 eV, it rises less than linearly. The initial slope is smaller by a factor of 3 than the earlier measurements of Nottingham. (3) Above 12 eV, excitation to the autoionizing states is seen, and above 18 eV, an additional contribution to the total cross section begins. The latter is due to ionization to an excited state of the ion. Cross sections for these two processes have been related to spectroscopic measurements of Beutler, et al., and have been separated from the basic ionizing channel. The curve for autoionization is resonant in nature with a maximum of 0.8Å^2. The ionization to the excited ion has an estimated maximum cross section of 1.5Å^2 at 60 eV. Author (TAB)

N66-16628# Aerospace Research Labs., Wright-Patterson AFB, Ohio
THE WAVE NATURE OF MOVING STRIATIONS
David A. Lee, A. Garscadden, and P. Bletzinger Oct. 1965 21 p refs
(ARL-65-202; AD-625189) CFSTI: HC $1.00/MF $0.50

The results are presented of time and space resolved measurements on the response of the positive column of a low-pressure glow discharge to external perturbations. From these the profile, structure and the backward wave nature of moving striations are clearly indicated. A new method of solution to the equation originally presented by Pekarek (Proceedings of Sixth International Conference on Ionization Phenomena in Gases, v. 2, p. 133) is shown to contain all of the experimental results including the dispersion of a pulse disturbance. A stability criterion is derived; especially useful is that the onset of striations in a discharge can be calculated from a quadratic equation. Author (TAB)

N66-16629# Arkansas Univ., Fayetteville. Dept. of Electrical Engineering.
INTERACTION OF PLASMA FLOWS AND MAGNETIC FIELDS Final Technical Report, 15 Nov. 1963–1 Jun. 1965
Denys O. Akhurst [1965] 79 p refs
(Contract DA-23-072-AMC-168(Z))
(UAPL-24; AD-625575) CFSTI: HC $3.00/MF $0.75

The report deals with power generation through the interaction of plasmas and magnetic fields. The study includes both theoretical and experimental work in magnetohydrodynamics and superconductivity. TAB

N66-16663# Air Force Cambridge Research Labs., Bedford, Mass.
HYDROMAGNETIC IONIZING WAVES
Allen G. Rubin and Ram S. Kishwaha Sep. 1965 22 p refs *Its* Phys. Sci. Res. Paper No. 146
(AFCRL-65-706; AD-625171) CFSTI: HC $1.00/MF $0.50

A theory of hydromagnetic ionizing waves has been developed which is valid in the region in which gas pressure is negligible, compared with magnetic pressure. The theory takes into account the energy expended in partial ionization of the gas behind the wave. The usual high conductivity boundary condition behind the wave is not employed. The electric field in front of the wave is taken as a parameter. Results of this theory are compared with available experimental measurements, and show good agreement. Author (TAB)

N66-16705*# National Bureau of Standards, Washington, D. C.
TURBULENCE IN A RAREFIED PLASMA
C. M. Tchen 15 Dec. 1965 12 p
(NASA Order R-127)
(NASA-CR-70040; NBS-9005) CFSTI: HC $1.00/MF $0.50 CSCL 20I

A theory is developed on the damping process in a turbulent plasma (nonlinear Landau damping). The Vlasov–Poisson equations, describing the turbulent fluctuations, generate a chain of equations for their correlations. If the fourth order correlations are degenerated into lower orders, the chain becomes closed. The result shows that the decay of the electrostatic wave energy is governed by a linear damping mechanism, i.e. the linear Landau damping of waves which is independent of the amplitudes, and a turbulent damping depending on the amplitudes. Author

N66-16719*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
WING-SLOPE TECHNIQUES FOR THE ANALYSIS OF LANGMUIR PROBE CHARACTERISTICS
Richard T. Bettinger Aug. 1965 28 p refs *Its* Tech. Rept.-484
(Grant NGR-21-002-057)
(NASA-CR-70018) CFSTI: HC $2.00/MF $0.50 CSCL 20I

The volt-ampere characteristics of Langmuir probes employing ideal geometries (spherical or cylindrical) contain a considerable amount of information, much of which is not utilized in the usual analysis programs. The slopes of the V-i curve for large accelerating potentials contain a substantial amount of information on mass density and temperature. We have developed equations for the current and its slope in this region for both of the above geometries and have applied them to a few typical situations. We conclude the usefulness of Langmuir probe techniques may be appreciably improved by performing a "total analysis" on the available information. In some cases, measuring the slopes directly will supply the same information with a substantial saving in experimental complexity. Author

N66-16722*# AVCO-Everett Research Lab., Everett, Mass.
THE PRODUCTION OF BeV POTENTIAL WELLS
G. S. Janes, R. H. Levy, and H. E. Petschek Jun. 1965 13 p refs
(Contracts NASw-1101; AF 49(638)-1553)
(NASA-CR-70015; AMP-166) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The production of large electrostatic potential wells by a cloud of electrons suspended in a magnetic field is discussed. The method avoids the usual breakdown limitations. Estimates presented on the cloud geometry, containment equilibrium, and on charge suggest that the BeV range may be accessible with large equipment. Ions introduced into the potential well can be both accelerated and contained. If the number of ions which can be contained by the method outlined is limited by the accumulation of positive space charge, it should be possible to produce an overall reaction rate of the order of 10^{16} nuclear reactions per second. A configuration of the theoretical electron cloud contained along the circular axis of a torus by a magnetic field parallel to the axis is depicted. L.S.

N66-16758# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET RESEARCH IN PLASMA PHYSICS Surveys of Soviet Scientific and Technical Literature
Frederick Pindy 5 Oct. 1965 212 p refs Compilation of Abstracts
(ATD-P-65-82)

Abstracts are presented on the following subjects: *Stability and Oscillations; Shock Waves; Electromagnetic Fields; Diagnostics; Containment; Production and Manipulation; Astrophysics; Magnetohydrodynamics;* and *Plasma Waveguides.* E.E.B.

N66-16813# Joint Publications Research Service, Washington, D. C.
ELECTRON TEMPERATURE AND DENSITY INSIDE A GAS DISCHARGE TUBE
Chun-Ch'en Lin, Ho-Hsing Ch'en, and Yung-Sung T'ang *In its* Transl. on Communist China's Sci. and Technol. 17 Jan. 1966 p 152–160 refs (See N66-16806 07-34) CFSTI: $6.00

Mixtures of helium and neon, helium and xenon, as well as pure xenon in gas discharge tubes were evaluated for their intensity of emitted light, the electron temperature, and the density at which the discharge conditions vary. The helium–neon discharge tube emitted two principle wavelength 11 530 Å and 6328 Å in the range from 0.5 to 2 mm; the 6328 Å light appeared in the region where the temperature of the electrons was highest. Output intensity from the helium–xenon mixture for the 2.026 μ excitation light was a few times larger than the one produced by pure xenon due to increased electron density in the gas mixture. It was concluded that electron density and temperature values should be as large as possible to get high intensity emission. G.G.

N66-16820# Illinois Univ., Urbana. Coordinated Science Lab.
ION OSCILLATIONS IN A WEAKLY TURBULENT PLASMA
Yoshi H. Ichikawa Nov. 1965 39 p refs
(Contract DA-28-043-AMC-00073(E))
(R-271; AD-624604) CFSTI: HC $2.00/MF $0.50

Ion oscillations in a high temperature electron–ion plasma with high frequency turbulent fluctuations are investigated by generalizing the quasi-linear theory to a spatially inhomogeneous system. It is found that the feedback effect of the high frequency fluctuation on the low frequency oscillation in the systems gives rise to a parametric growth of the ion acoustic mode even if the system has a stable velocity distribution with respect to the ion acoustic mode. Author (TAB)

N66-16939*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SEMICLASSICAL APPROACH TO CAPTURE COLLISIONS BETWEEN IONS AND POLAR MOLECULES
John V. Dugan, Jr. and John L. Magee Washington, NASA Feb. 1966 48 p refs
(NASA-TN-D-3229) CFSTI: HC $2.00/MF $0.50 CSCL 20I

Quantum mechanical average cross sections are derived for low velocity capture collisions between ions and polar molecules. These cross section expressions incorporate the rotational energy of the molecule and are derived from the Stark interaction potential. A classical upper limit which is good for all ion velocities is presented for the capture cross section. Also, an approximate cross section is derived from classical considerations for the regime of high ion velocity by simple averaging over the static orientations of the polar molecule. Finally, a numerical calculation of the capture cross section is performed by randomizing initial conditions for two hypothetical molecules with fixed rotational energy at high values of ion velocity. The Lagrangian equations of motion are solved to obtain the capture cross section from a collision ratio. These cross sections are decreasing functions of molecular rotational energy and ion-molecule relative energy. The cross sections are discussed in the context of experimental results and the quantum theoretical predictions. This study of collision between hypothetical molecular species is intended to serve as a preliminary description of such events. Author

N66-16950# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Electron and Plasma Physics.
PRODUCTION OF A HOT PLASMA BY DISCHARGE IN A STRONGLY INHOMOGENEOUS MAGNETIC FIELD
B. Angerth, J. Ehrensvard, and H. Persson 20 Jul. 1965 16 p refs
(Rept.-65-12) CFSTI: HC $1.00/MF $0.50

Theory behind a low density plasma predicts the possible existence of an electric field parallel to a magnetic field in the event the latter is inhomogeneous. This parallel electric field is studied by a Penning discharge in a magnetic mirror, and an attempt is made to accelerate ions to high energy by means of this field. If the mirror ratio is high, the voltage ratio, part of which may be located along the magnetic field, is also high. The heating of a cathode and the measured current indicate the presence of ions with a density between 10^{10} and 10^{11}/cm^3 and an energy of one to three keV. M.W.R.

N66-17037# Naval Weapons Lab., Dahlgren, Va. Weapons Development and Evaluation Lab.
THE PRESENT STATE OF THE NWL RF DISCHARGE INVESTIGATION
H. A. Schwab Nov. 1965 25 p refs
(W-20/65; AD-624455) CFSTI: HC $1.00/MF $0.50

Information gained about rf discharges to date is presented. Steady state rf discharges between clean electrodes of the same material were examined. Voltage-current characteristics of these discharges were recorded to gain a knowledge of their general behavior. Some photographs of waveforms obtained by these measurements are presented. TAB

N66-17068*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INTERACTIONS OF SPACECRAFT AND OTHER MOVING BODIES WITH NATURAL PLASMAS
Carol K. Sterkin Dec. 1965 198 p refs
(Contract NAS7-100)
(NASA-CR-70382; JPLAI/LS-541) CFSTI: HC $5.00/MF $1.50 CSCL 20I

A compilation of abstracts is presented on data concerning the interactions of a moving spacecraft (satellite, rocket, or missile) with the surrounding ionized medium: ionosphere, magnetosphere, or interplanetary plasma. Although most of the abstracts concern spacecraft phenomena, related ionospheric instrumentation, and data, the search also includes literature on interactions of other types of moving man made bodies and on similar natural phenomena. The material is presented under the following main headings: spacecraft, aircraft, small projectiles, celestial bodies, interplanetary matter, ionospheric research and related subjects, and selected references on related subjects. C.T.C.

N66-17071*# Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.
THEORETICAL AND EXPERIMENTAL STUDIES OF MAGNETO-AERODYNAMIC DRAG AND SHOCK STAND-OFF DISTANCE Progress Report, 8 Jul. 1965–7 Jan. 1966
[1966] 54 p refs
(Grant NsG-547)
(NASA-CR-70315) CFSTI: HC $3.00/MF $0.50 CSCL 20I

Experimental and analytical research findings are summarized in magnetoaerodynamic drag and shock stand-off distance studies. A diagnostic technique was developed and used to measure the free stream Mach number and the ratio of specific heats. This technique involves interpretation of experimental pressure measurements by means of computer generated tabular data. Magnetogasdynamic drag measurements were made under a variety of flow conditions, and these results are compared with theoretical predictions. Shock stand-off data was measured by a method which depends on the luminosity of the flow, and it was found that aside from the predicted increase in shock stand-off, the luminosity is altered ahead of the shock. C.T.C.

N66-17085*# College of William and Mary, Williamsburg, Va. Plasma Physics Lab.
NONLINEAR RESPONSE OF AN OSCILLATING DISCHARGE TO VERY HIGH FREQUENCY SIGNALS Technical Report No. 3, Jun. 1963–Aug. 1965
D. B. Raiford (M.A. Thesis) Aug. 1965 47 p refs
(Grant NsG-106-61)
(NASA-CR-70323) CFSTI: HC $2.00/MF $0.50 CSCL 20I

A general discussion of the appearance of nonlinearities in the governing equations for the behavior of a plasma is presented. An historical survey of nonlinearities in plasmas and their observation and description by earlier investigators are discussed in an effort to achieve a basic foundation for the subsequent presentation. Experimental apparatus, used to produce and investigate nonlinearities in an oscillating discharge, was assembled. A very high frequency signal applied to the anode of the discharge affects the direct current drawn by the discharge. This effect appears as a resonant change in the dc level near frequencies characteristic of the oscillating discharge. A quadratic dependence of the response on the applied signal level indicates a second-order nonlinearity. These nonlinear effects are observed only when the frequencies involved correspond to the characteristic modes of the system. Author

N66-17101*# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF TURBULENCE INSTABILITIES AT PLASMA-MAGNETIC FIELD INTERFACES Semiannual Report
Winston H. Bostick Oct. 1965 27 p refs
(Grant NsG-596)
(NASA-CR-70318; SIT-P174(12/65)) CFSTI: HC $2.00/MF $0.50 CSCL 20I

Results of experiments are reported which involve a short plasma coaxial accelerator, vortices in plasma flow over a magnetic dipole coil, and plasma flow in a coaxial geometry. Loop measurements were made of the radial current density using the coaxial accelerator. This accelerator exhibits the existence of well formed vortices following the current sheet when either polarity is applied to the center conductor. With a filling of hydrogen gas at 2000 microns pressure, the magnitude of the radial component of the diamagnetic current densities associated with the vortices is comparable with that of the current sheet. Image converter photographs were made with hydrogen and argon plasma flow over a magnetic dipole, and show clear evidence of the concentration of plasma in columnar vortices lined up with the magnetic field. Photographs were also made of the firing of a small two-wire plasma button gun into a B_0 produced by a coaxial system of copper conductors, and show the trajectories of the plasma vortices as they are reflected from the magnetic field. C.T.C.

N66-17214*# AVCO-Everett Research Lab., Everett, Mass.
THE EFFECT OF COHERENT RADIATION ON THE STABILITY OF A CROSSED-FIELD ELECTRON BEAM Research Report No. 213
R. H. Levy Jun. 1965 65 p refs
(Contract NASw-1101)
(NASA-CR-70372) CFSTI: HC $3.00/MF $0.75 CSCL 20I

It has been suggested that a toroidal space vehicle might be raised to a very high positive potential relative to the surrounding space by causing a stable crossed-field electron beam to circulate around its outer surface. The stability against coherent radiative perturbations of such a thick beam is studied under the following simplifying assumptions: (1) the geometry is taken as infinite cylindrical; (2) the ratio of all frequencies in the problem to the electron cyclotron frequency is negligible; (3) no perturbation electric fields along the magnetic field lines; (4) on the basis of an analogy, but without direct proof, certain continuous spectra of real eigenvalues occurring in the problem are unimportant; (5) the electrons are cold and (6) the outer boundary of the space vehicle, i.e. the cylinder, is perfectly conducting. It is concluded that if there is a gap between the inner edge of the beam and the cylinder, one unstable mode is present for each azimuthal mode number $l \geq 1$. Author

N66-17261*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELATIVISTIC CHARGED FLUID FLOW. II: GENERALIZED LARMOR AND HELMHOLTZ THEOREMS
Lawrence A. Schmid Oct. 1965 45 p refs
(NASA-TM-X-55389; X-641-65-421) CFSTI: HC $2.00/MF $0.50 CSCL 20I

The covariant Larmor theorem is derived within the framework of Special Relativity for an inviscid charged fluid in the presence of an arbitrary electromagnetic field and a gravitational field which is described by a simple scalar potential. The flow need not be adiabatic and the fluid need not be barotropic. The covariant form of the Larmor theorem, which is an

antisymmetric tensor equation, is equivalent to two 3-vector equations, one of which is the fluid equation of motion. The other is just the familiar 3-vector statement of the Larmor theorem except for an extra precession that is thermal in origin. The relativistic Helmholtz equation is derived for the covariant Larmor theorem. The vorticity is defined as the curl of the usual canonical momentum of a charged particle in an electromagnetic field except that the particle rest mass is a variable that includes contributions that are proportional to the gravitational potential and the specific enthalpy of the fluid. For this definition of the vorticity it is found that the vorticity flux diffuses through the fluid except when the flow is isentropic. It is shown, however, that when an appropriate thermal 4-potential is included in the definition of the canonical momentum, the vorticity flux remains frozen in the fluid even when viscosity is present and the flow is nonadiabatic. A microscopic interpretation of this generalized Helmholtz equation is given. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N66-16179*# Stanford Univ., Calif. Solid-State Electronics Lab.

FUNDAMENTAL STUDIES OF THE METALLURGICAL, ELECTRICAL, AND OPTICAL PROPERTIES OF GALLIUM PHOSPHIDE Quarterly Progress Report, 1 Oct.–31 Dec. 1965

G. L. Pearson et al [1966] 18 p refs

(Grant NsG-555)

(NASA-CR-69879) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Progress is reported for studies dealing with the optical, electrical, and metallurgical properties of the $GaAs_xP_{1-x}$ alloy system, preparation and characterization of rectifying junctions in GaP in this alloy system, properties of both GaP and the alloy system relevant to their use as semiconducting materials, and properties of cobalt as an impurity in GaP. M.W.R.

N66-16279*# Field Emission Corp., McMinnville, Oreg.

INVESTIGATION OF ELECTRON EMISSION CHARACTERISTICS OF LOW WORK FUNCTION SURFACES Quarterly Progress Report No. 4, 1 Jul.–30 Sep. 1965

L. W. Swanson, A. Bell, and L. C. Crouser 8 Dec. 1965 32 p refs

(Contract NASw-1082)

(NASA-CR-69821) CFSTI: HC $2.00/MF $0.50

A probe tube has been utilized to investigate several different aspects of cesium adsorption on tungsten, particularly on the (100) plane. The effect of both positive and negative fields on the cesium coverage of a (100) plane of a tungsten substrate has been completed. The two main field effects investigated were (1) field desorption and (2) the effect of applied field on the equilibrium distribution of cesium. Some indication of the magnitude of the dipole moment and the polarizability of the adsorbed cesium can be inferred from the results. In addition, the variation of the work function of the composite cesiated tungsten surface with temperature has been measured and was found to decrease with temperature on the (100) plane three times faster than the work function variation with temperature of the clean substrate. A more optimum set of conditions for operation of the "Van Oostrom" type energy analyzer tube has been found. A method is described by which absolute values of the work function and field of local crystallographic planes of a field emitter can be obtained from a combination of the energy distribution data and I–V characteristics of the emitter. Author

N66-16326# India. Dept. of Atomic Energy, Bombay.

PROCEEDINGS OF THE NUCLEAR PHYSICS AND SOLID STATE PHYSICS SYMPOSIUM. SOLID STATE PHYSICS

[1965] 345 p refs Symp. held at Saha Inst. of Nucl. Phys., Calcutta, 8–13 Feb. 1965

CFSTI: HC $7.00/MF $1.75

Selected subjects in solid state physics given at the symposium at Calcutta, India are presented. For individual titles see N66-16327–N66-16368.

N66-16327 Indian Inst. of Tech., Kanpur.

LATTICE DEFECTS AND ELECTRON PARAMAGNETIC RESONANCE AND POSSIBLE SPLITTING OF ENERGY LEVELS OF ATOMS OR IONS IN OCTAHEDRAL CRYSTALS DUE TO SETS OF EQUIVALENT NEIGHBORING DEFECTS

Putcha Venkateswarlu *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 1–14 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Lattice defects in alkali halide crystals doped with divalent impurities were studied by tracing the resultant charge imbalance through paramagnetic resonance methods. Resonance spectra from crystals doped with Mn^{2+} or Eu^{2+} disclosed the formation of associated ion pairs with the neighboring vacancy defects. Energy levels of pairs involving the first nearest neighbors were twelvefold degenerate, while those of pairs involving second, third, fourth and fifth nearest neighbors were sixfold, twenty-fourfold, twelvefold, and eightfold degenerate, respectively. Wave functions of these pairs were used to form representations of the octahedral point group O_h for crystals having rock salt structure and are shown in a table. G.G.

N66-16328 Tata Inst. of Fundamental Research, Bombay (India).

ELECTRON PARAMAGNETIC RESONANCE OF Eu^{2+} IN CdF_2 AND KCl

K. V. Lingam, P. G. Nair, and B. Venkataraman *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 15–21 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Spin resonances of Eu^{2+} impurities in CdF_2 cubic crystals were studied by electron paramagnetic resonance spectrometer employing superheterodyne detection at 60 Mc/s. The crystals were oriented in such a way that their magnetic field was in the (110) plane and the directions [100], [110], and [111] could be observed by magnet rotation. It was found that Eu^{2+} occupied a substitutional site in the CdF_2 lattice. Line widths of the extreme transitions were about twice that of the central $-1/2$ to $1/2$ transitions due to local imperfections in the crystal. Lacroix's formula was used to obtain spin Hamiltonian parameters for Eu^{2+} in CdF_2 and to compare these parameters with those found elsewhere for CaF_2. Observed parameters for Eu^{2+} in CdF_2 were essentially similar to those in CaF_2. Eu^{2+} in polycrystalline KCl is being investigated to determine the spins of some europium isotopes. G.G.

N66-16331 Indian Inst. of Science, Bangalore. Dept. of Physics.
COVALENCY EFFECTS IN THE ESR OF TRANSITION ION COMPLEXES
R. Srinivasan *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 41–52 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Reviewed are a number of experiments on covalent effects in the electron spin resonance of transition ion complexes that can not readily be explained by the crystal field theory. Weak covalent bonding of paramagnetic ions in ionic crystals reduces the orbital contribution to the observed g value and the magnitude of the hyperfine structure, and leads to a hyperfine interaction of the ligand ion nuclei with the paramagnetic ions. Nuclear magnetic resonance methods are difficult to use for any nucleus other than F. Available data on covalent complexes show low spin properties and a spin lattice relaxation time long enough to allow observation of ESR at room temperatures. Application of large second radio frequency powers for exciting the ENDOR transitions of N in Cu-phthalocyanine made it possible to detect energy terms of 10 Kc/s in the spin Hamiltonian. G.G.

N66-16332 Saha Inst. of Nuclear Physics, Calcutta (India).
COVALENCY EFFECTS OF LIGANDS ON RARE EARTH IONS IN CRYSTALS
A. K. Raychaudhuri and D. R. Ray *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 53–61 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Hydromagnetic orbital wave functions, taking into account covalency effects, were used to approximate crystalline electric field parameters for rare earth ions. It was found that distortion effects of 5s and 5p electrons, together with the overlap effects, produced a net shielding for the A_2^0 parameters and depressed the point model value. The net effect for A_6^0 parameters was found to be antishielding and thus raised the point model value to a better agreement with experimental results. G.G.

N66-16334 National Chemical Lab. of India, Poona.
NEW MECHANISMS OF TEMPERATURE INDEPENDENT FMR LINEWIDTH IN SOME MAGNETIC SYSTEMS
K. P. Sinha *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 67–76 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Calculations on electronic interactions in ferromagnetic metals of the iron group transition elements are presented with emphasis on the configurational coupling between s and d states. The exchange rate of magnons in the long wavelength region was used to calculate relaxation times of the pure s-d exchange, and the modifications due to s-d mixing with its corresponding distortions of the intra-atomic and the inter-atomic transfers. The new method therefore give rise to a line broadening spectrum without the shifting of resonance lines. G.G.

N66-16335 Saha Inst. of Nuclear Physics, Calcutta (India).
SPIN-LATTICE RELAXATION IN PARAMAGNETIC SOLIDS. I: ELECTRON PARAMAGNETIC CASE
D. K. Ray, T. Ray, and P. Rudra *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 77–80 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

The nature of the dynamic Hamiltonian and the spin-lattice relaxation of different types of paramagnetic ions in different symmetries are discussed. Emphasis is placed on nuclear magnetism where the static quadrupole splittings are much smaller and also much larger than the Zeeman field splittings. The general method of deriving the dynamic Hamiltonian follows the basic principle of tensorial break-up in any crystal point symmetry with inclusion of all orders of perturbational effects. The constants associated with the operator in the dynamic Hamiltonian are theoretically evaluated for each case from a knowledge of the crystal field states, and the strengths of orbit-lattice, spin-orbit, Zeeman, and hyperfine interactions. G.G.

N66-16336 Saha Inst. of Nuclear Physics, Calcutta (India).
SPIN-LATTICE RELAXATION RATES IN SOLIDS. II: NUCLEAR MAGNETISM
D. K. Ray, T. Ray, and P. Rudra *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 81–92 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

The dynamic Hamiltonian was utilized to derive the exact expression for nuclear spin-lattice relaxation rates in dilute paramagnetic solids. Considered were low temperature impurity relaxations and high temperature diffusion mechanisms. Phonon modes were obtained from the molecular complex surrounding the nuclear spin, and the values of the product of the constants were evaluated on the basis of point charge ligands for the XY_6 complex or the O_h group. The dynamic Hamiltonian was formed and used to induce spin transitions from the Zeeman level m to levels m±1 and M±2 with corresponding creation and annihilation of phonons. No account of optical phonons was made. G.G.

N66-16340 Indian Association for the Cultivation of Science, Calcutta.
TEMPERATURE DEPENDENT POLARIZED CRYSTAL SPECTRA OF TRANSITION METAL ION COMPOUNDS
Gobinda Basu *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 105–109 (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Electric dipole transitions of uniaxial crystals can be differentiated from magnetic dipole transitions by comparison of the axial (α), σ and π polarized spectra. Thus a system with $C_2\ v$ symmetry with both the states transforming as the $A1_g$ representation allows transition only in the z-direction and can be utilized to arrange the ground and excited states in order of increasing energy. Inclusion of odd frequency vibrations into the transitions eliminates the isotopic character of the bands and their total intensity can be written as:

$$f = a_{11} f_x + a_{12} f_y + a_{13} f_z$$

where a_{11}, a_{12}, and a_{13} are the direction cosine squares of the extinction direction and the molecular axes. Thus, crystal spectra of two different faces and along two extinctions decompose the total absorption curve into x, y, and z components. Polarized crystal spectra of two different faces of a d^1-system crystal became sharper with lowering of the temperature, and progression of the superimposed vibration on the electronic band was detected. Spin forbidden transition levels of similar electronic configuration appeared as sharp weak bands at low temperatures. G.G.

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N66-16341 Chicago Univ., Ill. Inst. for the Study of Metals.
ZEEMAN SPLITTING OF MOLECULAR SINGLET-TRIPLET TRANSITION
Mihir Chowdhury and Donald S. Mc Clure *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 110–114 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Triplet n transitions of bezoquinone and pyrazine crystals were studied by Zeeman splitting of the optical singlet–triplet transition in a 210 kilogauss field. Relative intensities of the Zeeman components, g-values, and zero-field splittings were measured. The g value of the triplet state was found to be isotropic and equal to 2.0 within the limits of the experimental error (2%). The singlet–triplet spectra of pyrazine crystal showed the presence of vibrational features along with the 0–0 band. The Zeeman pattern showed that the L_yS_y operator was responsible for the intensity of all the bands except the second band of the first doublet at the origin. Asymmetric splitting of some bands was attributed to zero-field splitting of the order of 1–2 cm^{-1}. G.G.

N66-16342 Allahabad Univ. (India).
ACOUSTIC SATURATION OF NMR LINES II
D. P. Tewari and G. S. Verma *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 115–123 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

A nuclear spin system for which all lines are resolved was used to study acoustic saturation of individual nuclear magnetic resonance lines. Expressions for the population difference between adjacent levels both for quadrupolar and magnetic relaxations were obtained in the presence of an ultrasonic field applied at Larmor frequency. Results for calculations on I=3/2, 5/2, 7/2, and 9/2 are summarized for quadrupolar relaxations and for magnetic relaxations. It was observed that a few satellites showed enhancement effects and some others attained a negative ratio of the population difference to its equilibrium value for higher values of the acoustic power. G.G.

N66-16343 Saha Inst. of Nuclear Physics, Calcutta (India).
DETERMINATION OF CRYSTAL PARAMETERS BY NUCLEAR QUADRUPOLE RESONANCE STUDIES
A. K. Saha *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 125–130 ref (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

A new method to find the cone of zero splitting from crystal nuclear quadrupole resonance (NQR) spectra is proposed. This procedure is applicable for half-integral spins only and can be used to determine the crystal parameters. It utilizes Cohen's expression for the Zeeman splitting of NQR levels to obtain the frequency splits into a quadrupole system whose components are given. Rotation variations are then studied for different orientations of the crystal. G.G.

N66-16345 Saha Inst. of Nuclear Physics, Calcutta (India).
ELECTRIC FIELD GRADIENT IN IONIC CRYSTALS
M. N. Ghatikar, J. Lahiri, and D. K. Ray *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 137–143 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

A strictly point charge ionic model was used to calculate the electric field gradient in Al_2O_3. Point charge distribution to the field gradient at the Al_1 site was evaluated as a lattice sum from induced dipole and quadrupole moments at all different Al^{3+} and O^{2-} sites. The complete lattice sum was taken over five layers of cells in the crystal. It was concluded that the contribution to the field gradient from induced dipole and quadrupole moments was much less compared to that due to point charges; the value of the quadrupole lattice sum itself was consistently about an order of magnitude larger than the dipole lattice sum. G.G.

N66-16347 Tata Inst. of Fundamental Research, Bombay (India).
KNIGHT SHIFTS IN RARE-EARTH-TIN INTERMETALLIC COMPOUNDS
S. S. Dharmatti, V. Udaya Shankar Rao, and R. Vijayaraghavan *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 152–156 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Conduction electron polarization spins in RSn_3 (R=La, Ce, Pr, Nd, Sm, and UO intermetallic compounds having f.c.c. structure of the $AuCu_3$ (L_1) type were studied by measuring their knight shifts and magnetic susceptibilities from room temperature down to 100°K. All compounds showed an enhancement for their Knight shifts with the exception of $SmSn_3$. The shifts in $PrSn_3$, $NdSn_3$, and USn_3 showed considerable temperature dependence. A table presents all the measured shift values for RSn_3 intermetallic compounds. G.G.

N66-16348 Tata Inst. of Fundamental Research, Bombay (India).
NUCLEAR MAGNETIC RESONANCE IN CADMIUM SELENIDE
S. S. Dharmatti, B. D. Mungurawadi, and D. L. Radhakrishna Setty *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 157–161 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Chemical and Knight shifts for the isotopes Se^{77} and Cd^{113} in intrinsic and n-type cadmium selenide semiconducters with cell dimensions a=4.31 Å and c=7.02 Å were measured at 120°K and 420°K. Se^{77} and Cd^{113} shifts were determined with respect to selenium metal and a saturated solution of $CdCl_2$ in 0.3 molar $MnSo_4$ respectively, and are presented in a table. It was found that the Se^{77} resonance in selenide appears in a higher field side than that of selenium metal and was probably caused by a chemical shift. This observed chemical shift of Se^{77} in CdSe was attributed to the combined effects of the higher ionicity in the chemical bonds and the higher symmetrical environment by the Se atom. G.G.

N66-16350 Indian Inst. of Science, Bangalore. Dept. of Physics.
NMR STUDY OF SOME PARAMAGNETIC HYDRATED FLUORIDES
K. R. K. Easwaran and R. Srinivasan *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 171–180 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Isotopic H^1 and F^{19} nuclear magnetic resonances on compounds of $MF_2{\cdot}4H_2O$ (where M=Mn, Fe, Co, Ni, and Zn) were observed at low temperatures before the onset of ferromagnetism. A wide line NMR spectrometer was utilized to measure resonances induced by a homogeneous field of 1 in 10^4 gauss over the samples. Proton magnetic resonance of $ZnF_2{\cdot}4H_2O$ at room temperature and at 90°K gave the usual two proton type line width of 11.2 gauss. The NMR of

$FeF_2 \cdot 4H_2O$, $CoF_2 \cdot 4H_2O$, and $NiF_2 \cdot 4H_2O$ were broader compared to the polycrystalline NMR spectra in the usual hydrates. Increased line widths at low temperatures were attributed to increased electronic polarization. F^{19} resonances were studied for the tetrahydrates of Fe, Co, Ni, and Zn fluorides. Except in the case of $ZnF_2 \cdot 4H_2O$ all showed large shifts of the resonance field from the free F^{19} value with a strong temperature dependence. Fractional dipolar shifts were calculated for the three nearest neighbors along with the values of molar susceptibilities at room temperature and are shown in graphic form. G.G.

N66-16354 Tata Inst. of Fundamental Research, Bombay (India).

THE COMPLETE ABSORPTION TECHNIQUE IN THE MEASUREMENT OF ABSOLUTE RECOIL-LESS FRACTION "F" IN THE MOSSBAUER EFFECT

R. Fatehally, N. P. Sastry, L. Nair, and R. Nagarajan *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 203–209 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Described is the Moessbauer black absorber technique that measures the absorption of a recoilless impurity atom into a host lattice. This method is based on the resonant absorption of the recoilless fraction f_a of gamma rays by an absorber consisting of identical nuclei. Resonance absorption is controlled by giving a small Doppler velocity to the absorber. An absorber was developed consisting of an appropriate mixture of ammonium fluoferrate and an iron–aluminum alloy as main components. Its absorption coefficient spectrum was obtained and is shown for a linewidth of 0.5 mm per sec. for each line. G.G.

N66-16356 Tata Inst. of Fundamental Research, Bombay (India).

A DETERMINATION OF THE DIFFUSION PARAMETERS OF VACANCIES

B. K. Basu *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 215–219 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Rapid cooling of electropolished aluminum crystals led to the development of thermal pits on their surfaces through formation of escape vacancies. An attempt to determine the diffusion parameters for vacancies from measurements of the widths of the thermal pit depleted regions near grain boundaries gave good preliminary results. G.G.

N66-16357 Allahabad Univ. (India) Dept. of Physics.

LATTICE THERMAL CONDUCTIVITY OF Si–Ge ALLOYS AT HIGH TEMPERATURE: ROLE OF TRANSVERSE PHONONS AND ELECTRON-HOLE PAIRS

Chandra Mohan Bhandari and G. S. Verma *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 220–224 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Presented is a thermal conductivity analysis of Si–Ge alloys in the temperature range of 300°K to 1200°K with emphasis on contributions from longitudinal and transverse phonons. Phonon spectra of Si–Ge alloys were used to obtain the values of zone boundary frequencies for acoustic longitudinal and transverse branches. It was assumed that the ratio of the frequency at which Umklapp processes start to the zone boundary frequency was the same in Si–Ge alloys as in the component to which the alloy can be approximated more closely. The developed thermal conductivity curves for Si–Ge alloy samples at high temperature showed a peak in the thermal resistivity versus temperature plot that was attributed to increased electronic bipolar thermal conductivity. G.G.

N66-16358 Rajasthan Univ., Jaipur (India). Dept. of Physics.

INTERATOMIC FORCES AND PROPERTIES OF CRYSTALS

C. M. Kachhava and S. C. Saxena *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 225–228 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Calculations on thermal expansion, Gruneisen constants, and dielectric constants of alkali halide crystals were performed by using the formula

$$\Phi(r) = -\frac{\alpha e^2}{r} + A \exp(-r/\rho) - \frac{C}{r^6} - \frac{D}{r^8},$$

where $\Phi(r)$ represents the potential energy of two neighboring atoms which interact with each other as well as with the rest of the lattice; α is the Madelung constant, e the electronic charge, r the interatomic separation distance, C and D the van der Walls constants, and A and ρ are the two potential parameters. Numerical calculations on thermal expansion agreed with experimental values within an average absolute deviation of 15.9%, showed reasonable agreement with Gruneisen values, but poor consistency with experimental dielectric constant values due to overlap of the neighboring ions. G.G.

N66-16384 India. Dept. of Atomic Energy, Bombay.

NEUTRON DIFFRACTION STUDY OF THE CRYSTAL STRUCTURE OF BERYLLIUM SULPHATE TETRAHYDRATE

S. K. Sikka *In its* Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 280–286 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Location of the hydrogen atoms in the crystal structure of beryllium sulphate tetrahydrates was investigated by neutron diffraction spectrometry. Complete diffraction profiles were recorded for 48 reflections from a coated crystal sample of cylindrical shape, and 10 reflections were measured by the peak intensity method. Analysis and refinement of the structural data established the SO_4 tetrahedron with a S–O distance of 1.489 Å, and the Be–O bond length as 1.609 Å. The hydrogen bonds in the structure were of a short type with the O_2–O_1 distances being 2.693 and 2.632 Å, respectively. The O–H distances were 0.947 Å and 1.125 Å with an HOH angle of 126.1 Å and a H–H distance of 1.849 Å. G.G.

N66-16385 India. Dept. of Atomic Energy, Bombay.

ATOMIC AND MAGNETIC STRUCTURE OF MnAlGe

R. J. Begum, N. S. Satya Murthy, M. R. L. N. Murthy, and C. S. Somanathan *In its* Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 287–291 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

A ternary alloy of nominal composition MnAlGe was studied by X-ray and neutron diffraction methods for structural evaluation with emphasis on its magnetic anisotropy. Diffraction lines from powdered alloy samples established a tetragonal structure with unit cell constants a=3.910 Å and C=5.943 Å. Analysis of the neutron peak intensities, taken at 1.27 Å wavelength and at room temperature as well as at 130°K, found measurable magnetic contributions only to the

(110) and (111) reflections. The sample retained its magnetization for considerable time after it had been placed in a magnetic field of 2 to 3 kOe. Preferential orientation of the magnetic moment was along the c-axis. The moment of Mn atoms in MnAlGe was 1.5, indicating that the replacement of Mn II atoms by Al does not affect the moment of Mn I. G.G.

N66-16367 Indian Inst. of Tech., Kanpur.
FREQUENCY DISTRIBUTION FUNCTION OF SOLIDS
K. G. Aggarwal, J. Mahanty, and V. K. Tewary *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 297–302 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Frequency distribution functions (FD) of solids were evaluated by utilizing sine functions as the basis for expansion of the frequency distribution function. Fourier series representation provided expansion for any additive functions of the normal mode frequencies of the lattice and was highly convergent. Example calculations for the FD of vanadium are presented that assumed an m-dimensional simple cubic lattice with nearest neighbor central and non-central forces being equal, and each atom having one degree of freedom. Qualitative agreement was obtained with values from a root sampling method performed elsewhere. G.G.

N66-16368 Indian Association for the Cultivation of Science, Calcutta.
LATTICE DYNAMICS AND DEBYE-WALLER TEMPERATURE FACTOR FOR ROCKSALT-STRUCTURE ALKALI HALIDES
A. V. Jagannadham *In* India. Dept. of Atomic Energy Proc. of the Nucl. Phys. and Solid State Phys. Symp., Solid State Phys. [1965] p 303–309 refs (See N66-16326 07-23) CFSTI: HC $7.00/MF $1.75

Lattice frequencies distributions at room temperature and at 0°K were used to calculate the Debye–Waller temperature factor and the characteristic temperatures for a number of alkali halides. The Debye–Waller temperature factor $\bar{B}$ for X-ray reflection at the temperature ToK was given by the formula

$$\bar{B} = \frac{2}{m_a} \int_0^{\nu_m} f(\nu) h\nu \left(\frac{1}{2} + \frac{1}{e^{h\nu/kT} - 1} \right) \Big/ \int_0^{\nu_m} f(\nu) d\nu$$

where m_a is the mean atomic mass of the vibrating ion or molecule, $f(\nu)d\nu$ the number of frequencies lying between ν and $\nu+d\nu$ while h and k are Planck's constant and Boltzmann's constant respectively. Corrections for displacement polarizations had little influence on the $\bar{B}$-values since the latter depended on the summation of the overall lattice frequencies. Calculated values for the Debye–Waller factor and the characteristic temperatures are presented for LiF, LiCl, NaF, NaCl, NaBr, NaI, KF, KCl, KBr, and KI. G.G.

N66-16392*# Radio Corp. of America, Princeton, N. J. RCA Labs.
INTERACTION OF ELECTRONIC CURRENT WITH HYPERSONIC WAVES IN SOLIDS Quarterly Progress Report No. 1, 1 Oct.–31 Dec. 1963
R. F. Mayo 10 Jan. 1964 14 p refs
(Contract NAS8-11120)
(NASA-CR-69814) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The possible device applications of ultrasonic amplification in piezoelectric semiconductors, particularly at ultra-high and microwave frequencies, are discussed. Power output, noise level, and efficiency are considered and the present situation in the construction of transducers for extracting r.f. power is surveyed. The phenomenon of current saturation in cadmium sulphide, which is thought to be a related effect, is also discussed. Author

N66-16410# Sheffield Univ. (England). Dept of Physics.
PARAMAGNETIC RESONANCE OF GADOLINIUM S-STATE IONS IN RARE EARTH METALS Final Report
A. M. Harris and R. S. Tebble 30 Jun. 1965 57 p refs
(Grant AF-EOAR-62-54)
(AFOSR-65-1507; AD-623816) CFSTI: HC $3.00/MF $0.50

Electron spin resonance and magnetic susceptibility measurements were made on a series of gadolinium alloys, in the temperature ranges where ferromagnetism, antiferromagnetism, and paramagnetism occur. G factors for the alloys were estimated in the paramagnetic region at high temperatures. The concentration dependence of the g factor of Gd dissolved in several rare earth metals was determined. The results cannot be explained on a simple indirect exchange Yosida model, and covalent mechansims as suggested by Kondo appear to play an important role. Author (TAB)

N66-16445*# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
A STUDY OF THIN FILM VACUUM DEPOSITED JUNCTIONS Annual Status Report, Dec. 5, 1964–Dec. 5, 1965
Robert L. Ramey Dec. 1965 34 p
(Grant NsG-340)
(NASA-CR-69863; EE-4012-105-66U) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Progress is reported on the theoretical research on the role of surface states in the control of the conductivity of thin films and electron tunneling in thin oxide films. Also, experimental research on field effect transistors, electron tunneling devices, microwave bolometers, and thin film magnetometers is discussed. Preliminary results of the theoretical considerations of the role of surface states point to the likelihood of extensive trapping of electrons in the body of the film as well as on the surface. Such trapping throughout the body of the film would explain the lack of control a field effect plate has over germanium polycrystalline films. Also, polycrystalline films of cadmium sulfide exhibit a variation in electrical conductivity by means of a field effect plate. E.E.B.

N66-16474# Air Force Inst., of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EXOELECTRON EMISSION FROM THIN FILMS
Duane Merle Mathias (M.S. Thesis) Aug. 1965 84 p refs
(GE/EE/65-16; AD-622426) CFSTI: HC $3.00/MF $0.75

Electron trapping in thin aluminum oxide films was investigated through the measurement of electron emission obtained while heating the excited sample through the temperature range of 0–420° C. Eight aluminum oxide films of different thicknesses were fabricated; six by vacuum evaporation and two by anodization. Results showed that films prepared by vacuum evaporation technique had traps distributed in energy with negligible retrapping. The films prepared by anodizing had two single valued traps of 1.29 ev for the deep traps and .69 ev for the shallow traps. Data indicated that as the film thickness decreases, the number of traps increases. Author (TAB)

N66-16514# Honeywell, Inc., Hopkins, Minn. Research Center.
BASIC MECHANISMS OF STRAIN HARDENING IN CERAMICS Thirty-Second Technical Report
Robert J. Stokes Oct. 1965 64 p refs Presented at Sagamore Army Mater. Res. Conf. on Strengthening Mech. in Metals and Ceramics, Sagamore, N. Y., 1965
(Contract Nonr-4076(00))
(HR-65-274; AD-623887) CFSTI: HC $3.00/MF $0.75

The paper deals with fundamental studies of strain hardening in rock salt structure ceramics. Strain hardening at low temperatures is primarily associated with dislocation interactions within single slip bands. As the slip band structure varies so the mechanism controlling strain hardening changes. It may involve dislocation–dislocation interaction (Taylor hardening), dislocation–dipole interaction, or dislocation–prismatic loop interaction depending on the particular material and test temperature. Strain hardening at intermediate temperatures is associated with multiple slip. Conjugate slip is much less effective in hardening a crystal than oblique slip, principally because dislocations with oblique Burgers vectors react to form sessile dislocations. Strain hardening due to conjugate slip completely disappears at high temperatures and crystals deforming by this mode become plastically unstable. Strain hardening due to oblique slip never disappears. At high temperatures, the dislocation reaction generates stable dislocation networks which constitute the major barrier to dislocation movement. Author (TAB)

N66-16517# Naval Ordnance Lab., White Oak, Md.
MATRIX ELEMENTS AND PARTIAL TRACES OF PRODUCTS OF PAIRS OF SPIN OPERATORS
Louis F. Libelo 22 Oct. 1965 17 p ref
(NOLTR-65-169; AD-624128) CFSTI: HC $1.00/MF $0.50

Matrix elements and partial traces have been calculated for products of pairs of components of two commuting vector angular momentum operators. Author (TAB)

N66-16609# Frankford Arsenal, Philadelphia, Pa. Pitman-Dunn Research Labs.
FERROELECTRICS: THEIR ELECTRICAL BEHAVIOR DURING, AND SUBSEQUENT TO, IONIZING RADIATIONS
I. Lefkowitz, K. Kramer, and P. Kroeger Nov. 1965 146 p refs
(R-1779; AD-625051) CFSTI: HC $4.00/MF $1.00

A study was made on certain ferroelectric materials which are among those used extensively in military applications, both in a polarized condition in such items as impact fuzes and in an unpolarized condition as capacitors. The transient voltages across a load produced by charge generated on the surface of various types of ferroelectric specimens during irradiation have been measured. These outputs were found to vary widely in amplitude and polarity even from specimens ostensibly alike (i.e., from the same lot of a given manufacturer), and even from a single specimen pulsed repeatedly with gamma and neutron radiation. Pulses were found to vary from background levels to a high of 300 volts on a large specimen with a load of 10^7 ohms and radiation of 5.4×10^{14} fast (Pu) neutrons and associated gammas. The maximum voltage possible is unknown, as are the factors causing the variation. Both polarized and unpolarized specimens showed outputs well above background transients. Some specimens were identical to those used in impact fuze applications and were in simulated housings which reproduce the mechanical environment of the device. Some fuze circuits in present use are discussed with reference to their use of ferroelectric materials and a calculation of the energy transferred by a voltage pulse to a load is presented.
Author (TAB)

N66-16662# Air Force Cambridge Research Labs., Bedford, Mass.
EFFECTS OF EXPERIMENTAL PARAMETERS ON THERMOLUMINESCENCE OF A TYPE II-A DIAMOND
Albert D. Johnson and James R. Littler Oct. 1965 40 p refs
Its Phys. Sci. Res. Paper No. 153
(AFCRL-65-749; AD-625169) CFSTI: HC $2.00/MF $0.50

Thermoluminescence provides a method for studying properties of those crystalline imperfections which behave as electron traps and recombination centers in wide bandgap materials. This approach, however, has been used relatively little, possibly due to the fact that the shapes and intensities of thermoluminescent glow curves are functions of several experimental parameters and are often complicated by the overlapping of a number of individual glow peaks. In the present work, experimental parameters were isolated and some of their effects on thermoluminescent glow curves were analyzed. This yielded information on activation energies associated with trapping levels, the nature of the kinetics involved in electron transitions, and electron retrapping. A Type II-A diamond, which has a wide distribution of thermoluminescent glow peaks, was used in this work. Author (TAB)

N66-16681# Controls for Radiation, Inc., Cambridge, Mass.
INVESTIGATION OF RADIATION INDUCED SEMI-CONDUCTOR PROPERTIES IN ORGANIC MATERIALS Final Report, 15 Jun. 1964–15 Jun. 1965
Paul A. Andrews, Sumner Mayburg, and James A. Wall 15 Jun. 1965 47 p refs
(Contract AF 19(628)-4240)
(AFCRL-65-720; AD-624884) CFSTI: HC $2.00/MF $0.50

Phenanthrene was purified by zone-refining methods and the resistivity of the material was determined as a function of temperature. A discontinuity in the resistivity temperature curve was observed at about 68° C for both compressed polycrystalline pellets and single crystals, and this discontinuity was intensified in the purer portions of the material. Various possible explanations are discussed. Attempts to zone-refine low-and high density polyethylene resulted in a brittle material which cracked on cooling. No segregation of impurities was observed. Electron irradiation of both silicon and selenium solar cells indicated that silicon cells are more resistant to radiation damage than selenium cells. Carrier removal in silicon appears to be responsible for the radiation induced fluctuation in the base resistance and emitter efficiency of silicon transistors. Author

N66-16711*# Radio Corp. of America, Princeton, N. J.
INTERACTION OF ELECTRONIC CURRENT WITH HYPERSONIC WAVES IN SOLIDS Technical Summary Report, 1 Oct. 1963–30 Sep. 1964
R. F. Mayo and R. W. Smith Nov. 1964 31 p refs
(Contract NAS8-11120)
(NASA-CR-70028) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Noise-spectrum measurements were made of the electrical noise in CdS in the current-saturated region. However, it became apparent that more direct methods of observing or detecting phonons at microwave frequencies are required. It appears possible that circuit effects are distorting the present measurements and making their interpretation difficult. Consequently, we are now concentrating on optical methods as a means of avoiding these difficulties, and three schemes are being developed. A new mode of low-frequency oscillations has been observed in CdS crystals which lends support to the "Monotron" model mentioned in previous reports as possible explanation of the low-frequency current oscillations. With

some reservations on the possibility of circuit effects, our measurements suggest that the low-frequency (for example, ≈10 Mc/sec) oscillations and noise may be more fundamental to the current saturation than has heretofore been believed. Author

N66-16740# Stanford Univ., Calif. Microwave Lab.
LASER MATERIAL (SPECTROSCOPY) Semiannual Report No. 1, Dec. 15, 1964–Jun. 15, 1965
Jul. 1965 132 p refs
(Contract DA-28-043-AMC-00446(E))
(ML-1346; AD-621488) CFSTI: HC $4.00/MF $1.00

CONTENTS:
1. LUMINESCENCE IN RARE EARTH MATERIALS p 1–33 refs (See N66-16741 07-26)
2. SPECTRAL CHARACTERISTICS OF LASER OSCILLATORS p 34–118 refs (See N66-16742 07-16)

N66-16741 Stanford Univ., Calif. Microwave Lab.
LUMINESCENCE IN RARE EARTH MATERIALS
In its Laser Mater. (Spectry.) Jul. 1965 p 1–33 refs (See N66-16740 07-26) CFSTI: HC $4.00/MF $1.00

The line structure of the photoluminescence of ZnS:Tb, ZnS:Nd, ZnS:Tm and ZnS:Dy has been studied under various preparative conditions. There is a strong tendency for rare earth pairing with other lattice defects in the presence of excess S. This pairing is manifested by the appearance of new emission and excitation bands. Of the many distinct sites for the rare earth ion, one seems to stand out as most important in electroluminescence although it gives only a minor contribution to the photoluminescence. Using a variety of luminescent phenomena, we are able to count at least four distinct sites for trivalent rare earth ions in ZnS and there is strong evidence that more exist. Preparation of CdS:Nd has been achieved so that reasonably strong Nd^{3+} emission is obtained. A multiplicity of Nd^{3+} sites is evident. Emission of CdS:Er has also been observed. Tunnel injecting contacts have been formed on slices of a single crystal of CdS:Nd. Author

N66-16745# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE RESEARCH, 1 May–31 July 1965
4 Nov. 1965 87 p refs
(Contract AF 19(628)-5167)
(ESD-TDR-65-318; AD-624611) CFSTI: HC $3.00/MF $0.75

The report covers in detail the solid state research work at Lincoln Laboratory for the period 1 May 1965 through 31 July 1965. The topics covered are Solid State Device Research, Laser Research, Materials Research, and Physics of Solids. Author (TAB)

N66-16823# Chicago Univ., Ill. Institute for the Study of Metals.
ZEEMAN SPLITTING OF NARROW LINES IN CRYSTALLINE MnF_2, FeF_2, AND CoF_2. EVIDENCE FOR SPIN-WAVE EXCITATIONS
Philip G. Russell, Donald S. Mc Clure, and J. W. Stout [1965] 9 p refs
(Contract Nonr-2121(13))
(TR-19; AD-624803) CFSTI: HC $1.00/MF $0.50

The Zeeman splitting of narrow lines in the optical spectrum of crystals of MnF_2, FeF_2, and CoF_2 was measured at 4.2° K and in applied magnetic fields of 170 kG. All of the transitions observed are intercombinations for which $\Delta S = -1$. These crystals all have the rutile structure. The behavior of narrow lines in the 5450 A region of the MnF_2 spectrum is shown as the external magnetic field is applied parallel to the c axis (z direction) of the crystals. The lines arise from transitions from the ground $^6A_{1g}$ state to the lowest $^4T_{1g}$ excited state and are at slightly lower energy than the vibronic band for this transition. Similar results for the 3800 Å region of FeF_2 are shown. In each case two magnetic dipole transitions, separated by 17.2/cm for MnF_2 and 35.9/cm for FeF_2 appear, followed at higher energies by electric dipole transitions. The latter do not split in the external magnetic field, in the case of MnF_2, and split less than half as much as the magnetic dipole lines in the case of FeF_2. TAB

N66-16824# Linde Div., Union Carbide Corp., Indianapolis, Ind. Speedway Labs.
SYMMETRICAL LASER CRYSTALS Final Technical Report, 1 May 1963–31 Oct. 1965
O. H. Nestor 30 Nov. 1965 75 p refs
(Contract Nonr-4131(00); ARPA Order 306-62)
(SRCR-65-9; AD-624514) CFSTI: HC $3.00/MF $0.75

The development of cubic perovskites as symmetric hosts for laser dopant ions is of interest because long fluorescent lifetimes are to be expected. Other work on $LaAlO_3$:Cr appears to confirm this. The simple II-IV perovskites are of interest as hosts for divalent and tetravalent dopants, but only four such compounds $SrTiO_3$, $SrSnO_3$, $BaSnO_3$ and $BaZrO_3$ are known to be cubic at room temperature. The low dielectric properties and stability toward reduction of $BaZrO_3$ makes it the most attractive potential host. The refractory nature of this compound has heretofore prohibited melt synthesis of single crystal $BaZrO_3$. A novel crucible-less melting technique, referred to as skull-melting, was studied intensively as a means for producing single crystals of $BaZrO_3$ (and $SrTiO_3$). The process involves inductive coupling of electromagnetic radiation directly to the melt which acts as its own susceptor. The effects of many of the numerous variables, both thermal and electrical, on the process were studied. The coupling of energy is found to depend primarily on the frequency and the size and electrical conductivity of the melt. Numerous experiments demonstrated that $SrTiO_3$ (and $BaTiO_3$) may be fused by this process in a nearly reproducible manner and maintained in the molten state apparently indefinitely. Many attempts were made to pull single crystals of $SrTiO_3$ (and $BaTiO_3$) but only dark, polycrystalline masses of partially deoxidized material were obtained. TAB

N66-16877 Tohoku Univ., Sendai (Japan). Research Inst. for Iron, Steel and Other Metals.
MAGNETO-OPTICAL EXPERIMENT WITH SUPERCONDUCTING MAGNET
Yuichiro Nishina, Susumu Kurita, and Kunihide Tanaka *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 525–529 refs (See N66-16826 07-23) CFSTI: $8.50

Superconducting magnets have been designed and used for magneto-optical experiments on various semiconductors. A typical magnet is a solenoid with rectangular cross section (6 mm×16 mm) of semicircular ends situated so that the major protion of the light flux from a monochromator could be incident on a rectangular sample with approximate area of 2 mm×10 mm. The solenoid was wound with copper-plated Nb–Zr wire and produced the maximum field of 20.2 kgauss at 4.2°K. The field was monitored in terms of the magnetoresistance and an Sb probe which was

calibrated with the solenoid up to the field of 80 kgauss. The superconducting solenoid was used for measuring the interband Faraday rotation in GaSe in the photon energy range from 1.97 eV to 2.17 eV at 1.77°K. Author

N66-16880 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
THE POTENTIAL OF INTERSTITIAL COMPOUNDS FOR HIGH-FIELD SUPERCONDUCTING MAGNETS
N. Pessall, C. K. Jones, and H. A. Johansen *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 541–549 refs Sponsored by AF (See N66-16826 07-23) CFSTI: $8.50

Development of materials for superconducting magnets at fields above 100 kG has been concentrated almost exclusively on β-tungsten-type compounds. It is surprising, that in spite of the high critical temperature (T_c = 17.8° K) reported for niobium carbonitride, little attention has been paid to the potential of solid solutions of interstitial compounds in the development of high-field superconducting magnet materials. In the present work systematic measurements have been made of critical field (H_{c2}), critical current density (J_c) and T_c of some pseudo-binary systems of interstitial compounds (NaCl structure) based on niobium nitride, and also of several pseudo-ternary systems based on niobium carbonitride. A systematization of the superconducting behavior is given, and the potential of this class of materials discussed. Author

N66-16881 AVCO-Everett Research Lab., Everett, Mass.
TERMINAL CHARACTERISTICS OF SHORT SAMPLES OF SUPERCONDUCTORS AND THEIR EFFECT ON COIL BEHAVIOR
Z. J. J. Stekly *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 550–559 refs (See N66-16826 07-23) CFSTI: $8.50

The testing of short samples of superconducting materials has generally been restricted to measuring the current carrying capability in the presence of a magnetic field. The simulation of coil performance by varying the magnetic field at constant current, or varying the magnetic field simultaneously with the sample current (as opposed to the more conventional method of varying the current at constant field) does not correlate directly with coil behavior. If the behavior of short samples is characterized by their terminal characteristics, it is shown that in addition to the critical current, a recovery current exists. This paper presents experimental measurements of the terminal characteristics of short samples of cables and composite strips. From the experimentally measured terminal characteristics of short samples the terminal characteristics of a superconducting coil wound with the same conductor are readily determined. It is concluded that the best performance is achieved with conductors that are well cooled and have a low normal state resistivity. Author

N66-16882 Argonne National Lab., Ill.
EXPERIMENTS WITH SUPERCONDUCTING CABLE
Charles Laverick *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 560–567 refs (See N66-16826 07-23) CFSTI: $8.50

The performance characteristics of a number of magnets made from various types of superconducting cable are described. The effects of variations in the type of impregnating material, the thickness of the normal conductor, and the type of cable insulation used in the cable have been investigated. A striking feature of this type of superconductor, which is revealed by the experiments, is its ability to withstand a great degree of rough handling, winding and unwinding, metal dipping, acid cleaning, and heat treatment without affecting its performance adversely. Author

N66-16885 California Univ., Berkeley. Lawrence Radiation Lab.
THE FEASIBILITY OF A LOW-FIELD SUPERCONDUCTING THIN-SEPTUM MAGNET
Michael A. Green *In* Stanford Univ. Proc. of the Intern. Symp. on Magnet Technol. 1965 p 588–593 refs (See N66-16826 07-23) CFSTI: $8.50

The use of superconductors on a thin-septum magnet with a field strength of less than 10 kG is discussed. Stability criteria are identified as the basis of magnet conductor design, and the stability parameter is defined as the ratio of the heat generated in the conductor, or added from an outside source, to the heat removed in the helium bath. The current fraction in the substrate for stabilized superconductors is plotted. The design requirements for a thin extraction septum are related to their dependency on the energy of the particle to be extracted, and the length allowed for extraction. The lengths of 5 kG magnet required for various bending angles at different proton energies are tabulated. The effect of beam impingement on magnet performance are listed as the heating of the thin conductor, and the radiation-induced property changes in the superconductor, substrate, and insulation. It was concluded that the magnet will be feasible if there is no interaction with an accelerated beam; however, its feasibility is questioned if such interaction is required. M.G.J.

N66-16925*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CURRENT DISTRIBUTION IN AN ARRAY OF SUPERCONDUCTING THIN FILMS
I. D. Skurnick, J. H. Simmons, and A. R. Sass Washington, NASA, Feb. 1966 16 p refs
(NASA-TN-D-3293) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The conservation-of-fluxoid approach is used to derive the integral relations describing the current distribution in a general array of cylindrical London superconductors. This approach highlights properties of the kernel of the integral equation that permit the development of analytic solutions for a 2 by 2 array of closely spaced thin films of rectangular cross section. It was found that the current is distributed across the width of the film in a nonlinear, and nonsymmetric fashion, peaking at both edges. This peaking, in turn, dictates the switching characteristics of the system. It is shown that the dependence of the peaking on the separation distance between coplanar films can cause considerable variations in the critical current of the system I_c as this separation is varied from 1 to 20 times the film thickness. Author

N66-16945# Library of Congress, Washington, D. C. Aerospace Technology Div.
COMPOUND SEMICONDUCTORS Surveys of Communist World Scientific and Technical Literature
Boris Ofrossimow 30 Dec. 1965 79 p refs
(ATD-65-99)

This analytical survey is based on Soviet-Satellite open sources published 1953–1964. It is the first report in this series and it consists of a foreword, an analysis of data for the entire year 1963, and an annotated bibliography with 139 entries. Section 1 of the bibliography ($A^{III}B^{V}$ compounds) is comprised of 46 entries. Section 2 ($A^{II}B^{VI}$ compounds) of

70 entries, and Section 3 ($A^{IV}B^{IV}$ compounds) of 3 entries. There are 3 appendixes: (1) Topic Tags Index; (2) Author Index; (3) Associations Index. The following compounds are covered: indium phosphide, indium antimonide, gallium antimonide, gallium arsenide, gallium phosphide, aluminum nitride, cadmium telluride, gallium nitride, indium nitride, boron phosphide, cadmium selenide, cadmium sulfide, mercury sulfide, zinc sulfide, zinc telluride, mercury telluride, and silicon carbide. According to the analyst the following trends have become apparent: (1) the number of studies made by noncentrally located scientific institutions has increased at the expense of the central institutes; (2) a certain specialization of research institutions is apparent; (3) new facilities are being developed. Author

N66-16976*# Rice Univ., Houston, Tex.
SPIN-LATTICE INTERACTION IN RUBY MEASURED BY ESR IN UNIAXIALLY STRESSED CRYSTALS
R. B. Hemphill, P. L. Donoho, and E. D. Mc Donald [1965] 28 p refs Submitted for Publication
(Grant NsG-6)
(NASA-CR-70186) CFSTI: HC $2.00/MF $0.50 CSCL 20L

The spin-lattice Hamiltonian first proposed to explain electronic spin-lattice relaxation has been experimentally determined for Cr^{3+} ions in ruby single crystals. Its magnitude was obtained through measurements on the effect of applied uniaxial stress on the ESR spectrum of the Cr^{3+} ions. The spin-lattice Hamiltonian was found to be a quadratic spin operator, in agreement with Van Vleck's prediction, with no evidence for any other spin dependence. It was also determined through these measurements that the Cr^{3+} ions can be considered, for interactions with lattice modes, to occupy two inequivalent types of site in the Al_2O_3 lattice. Author

N66-17007# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
CRYSTALS FOR OPTICAL MASER APPLICATIONS Second Quarterly Progress Report, 1 May–31 Jul. 1965
J. B. Schroeder and J. F. Nester 31 Aug. 1965 34 p refs /ts Rept.-2
(Contract DA-28-043-AMC-00474(E))
(PE-TR-8110; AD-624558) CFSTI: HC $2.00/MF $0.50

This paper contains a discussion of experimental annealing techniques designed to relieve mechanical strain within $Gd_3Ga_5O_{12}$ crystals. In addition, the techniques and data used for the measurement of excitation spectra, fluorescent lifetimes, large-angle scattering, and fluorescence linewidths for several neodymium-doped glasses are discussed. The analysis of data taken for the room-temperature ruby R_1 linewidth revealed instrument broadening effects, and various approaches to this measurement were examined. This report also mentions an optical walkie-talkie device, but details of the work on this instrument are deferred to a later report. Descriptions of the various optical components fabricated and delivered to the customer during the second quarter are also included. Plans for experimental work to be conducted during the next quarter are given. Author (TAB)

N66-17021# Pennsylvania Univ., Philadelphia. Dept. of Physics.
THE PRESENT STATUS OF THE TEMPERATURE DEPENDENCE OF MAGNETOCRYSTALLINE ANISOTROPY, AND THE $J(J+1)/2$ POWER LAW
Herbert Callen and Earl Callen (Osaka Univ.) Aug. 1965 47 p refs Prepared in Cooperation with Osaka Univ.
(Contract Nonr-551(36))
(AD-624718) CFSTI: HC $2.00/MF $0.50

The theory of the temperature dependence of magnetocrystalline anisotropy in ferromagnetic insulators is reviewed and summarized. The $J(J+1)/2$ power law for the behavior at low temperatures is derived in a general fashion and the extension to arbitrary temperatures is also given. It is then shown that the $J(J+1)/2$ power law is not directly applicable to antiferromagnets, but that contrary to current opinion, quantum corrections to the ground state introduce significant alterations. The magnetic field dependence of the anisotropy energy and the $J(J+1)/2$ power law for the temperature dependence of magnetostriction are discussed. Author (TAB)

N66-17024# Pennsylvania Univ., Philadelphia. Dept. of Physics.
RARE-EARTH-IRON EXCHANGE INTERACTION IN THE GARNETS. II: EXCHANGE POTENTIAL FOR YTTERBIUM
Peter M. Levy Sep. 1965 41 p refs
(Contract Nonr-551(36))
(TR-26; AD-624719) CFSTI: HC $2.00/MF $0.50

To determine the magnitude of the anisotropy of ytterbium–iron (Yb-Fe) exchange interaction we have evaluated the exchange splittings of the lowest $^2F_{7/2}$ and $^2F_{7/2}$ doublets of ytterbium Yb^{3+} in ytterbium iron garnet. By using the wave functions of Yb^{3+} in yttrium gallium garnet (those for YbIG are not known) these splittings are expressed in terms of ten parameters which characterize the anisotropy of the exchange interaction. As there are only six experimental splittings it is necessary to reduce the number of unknowns by assuming: (1) that the rare-earth–iron (RE–Fe) exchange interaction take place through the neighboring eight oxygen ions, and (2) (somewhat more uncertainly) that the rare-earth–oxygen (RE–O) exchange interaction is axial about the RE-O axis. This leads to expressing the exchange splittings in two sets of four exchange constants. A good four parameter fit of the experimental exchange splittings was found by adopting essentially zero values for the rare-earth–ferric ion exchange interactions that take place through the nearest neighbor oxygen ions (at 2.37Å). Author (TAB)

N66-17031# Victory Engineering Corp., Springfield, N. J.
THIN FILM THERMISTORS Interim Development Report, 22 Jun.–27 Sep. 1965
[1965] 104 p refs
(Contract NObsr-93292(1737))
(AD-624465) CFSTI: HC $4.00/MF $0.75

The thermistors to be developed under this program are discrete components and of course may be adapted to a variety of applications besides microcircuitry. They may be used for surface temperature sensing, probes and any of the applications for which thermistors are used. The geometrical shape may be a film on a disk, rod or flat wafer, this again according to the application. The equipment with the exception of the R. F. Unit Power Supply is set up and operating. Various parameters have been established so that uniform coatings can be obtained at various rates of deposition. Rates of deposition have also been established for various elements and compounds as well as completion of a literature survey. Rates of deposition for volume resistivities of 300 ohm cm are somewhat slow, but very controllable, and are still useful. Ratios can be maintained from the bulk to film thickness down to 100 A. Surface resistivities are somewhat high as one might expect from so thin a film. Electrodes of gold have proven feasible and platinum leads (.001 diameter) have been successfully welded to these electrodes. Author (TAB)

N66-17034# California Univ., Los Angeles. Dept. of Physics.
MAGNETOSTATIC MODES IN ANTIFERROMAGNETS AND CANTED ANTIFERROMAGNETS
D. E. Beeman [1965] 7 p refs
(Contract Nonr-233(88))
(AD-624445) CFSTI: HC $1.00/MF $0.50

The resonance frequencies of the magnetostatic modes are calculated for an antiferromagnetic sphere with a d.c. magnetic field applied along the direction of easy magnetization. For resonance at a fixed frequency, the separations between the various modes are of order $0.2(2H_{ex}H_A)^{1/2}$ $4\pi M/H_{ex}$ oe. The magnetostatic modes of canted antiferromagnets of the α-Fe_2O_3 type are also investigated. Application of the magnetostatic conditions and solution of the differential equation for the magnetic scalar potential for a spherical sample reveals separations between modes of order $0.1(H_0 + H_{DM})$ $4\pi M/H_{ex}$ oe. These modes are associated with the low frequency resonance near $\omega_1 = \gamma[2H_{ex}H_A + H_0(H_0 + H_{DM})]^{1/2}$. Author (TAB)

N66-17180# Rutgers Univ., New Brunswick, N.J. School of Chemistry.
INTERMOLECULAR BONDING EFFECTS IN Sn^{119m} MOESSBAUER SPECTROSCOPY
R. H. Herber and H. A. Stoeckler [1965] 16 p refs Presented at Meeting of the Advisory Panel on Moessbauer Spectroscopy of the Intern. Atomic Energy Agency, Vienna, 26-30 Apr. 1965
(Contract AT (30-1)-2472)
(CONF-650425-3) CFSTI: HC $1.00/MF $0.50

It was shown that 6 coordination was neither a necessary nor a sufficient condition for the observation of measurably large Mössbauer resonance effects at room temperature as was previously presented. From a consideration of melting points and heat of phase transition for organometallic solids as compared to pure metals it was found that the intermolecular forces between molecular units was much smaller than the interatomic forces in a metallic lattice. Moreover the molecular weight of the compound was insufficient by large to reduce the recoil energy to values less than the natural line width of the Mössbauer nuclide. The number of lattice vibrational states that can be populated at a given experimental temperature is larger than it is in the case of metallic lattice. For this reason, even lower temperatures are required to observe measurably large resonance effects in the case of molecular solid organo-tin absorbers than is required of the simple metallic tin lattice. The presence of strong intermolecular bonds reduces the density of vibrational states and thus increases the recoil-free fraction, which is observed at a given temperature. NSA

N66-17215*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Science and Engineering.
A CALCULATION OF PROTON-INDUCED DAMAGE IN GERMANIUM
Edward A. Saunders and Gerald P. Calame [1964] 39 p refs Submitted for Publication
(Grant NsG-371)
(NASA-CR-60859) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Experimental work of Corelli and Fischer involving high-energy proton irradiation of germanium shows disagreement between observed results and earlier damage calculations. This work accounts for the observed results by means of a complete optical-model calculation of elastic and inelastic cross sections and the use of the channeling theory of Oen and Robinson in the treatment of the displacement cascade. The model of Seitz and Koehler is used to account for the transition between elastic and inelastic reactions involving the high-energy primary knockons. Calculations were run for proton energies from 5 Mev to 140 Mev. The results show that agreement with experiment is obtained using the sharp cutoff of Seitz and Koehler between elastic and inelastic reactions provided the nonhomogeneity of the crystal is taken into account through the use of the Oen and Robinson channeling model. Author

N66-17225*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE ANALYSIS OF THE DIELECTRIC DISPERSION OF FERRITES
P. H. Fang [1964] 11 p refs Submitted for Publication
(NASA-TM-X-54959) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Several models which have been used to analyze the low frequency dielectric dispersion of Ni-Zn or Mn ferrites are discussed. Based on the analytic nature of the dispersion functions corresponding to these models, it is shown what experimental data are required to decide the validity of specific models. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N66-16960# Atlantic Research Corp., Alexandria, Va. Kinetics and Combustion Div.
RESEARCH ON COMBUSTION IN SOLID ROCKET PROPELLANTS. HYDRAZINE NITROFORM AS A PROPELLANT INGREDIENT Final Technical Report
G. von Elbe, R. Friedman, J. B. Levy, and S. J. Adams 21 Jul. 1964 26 p refs
(Contract DA-36-034-AMC-0091(R))
(AD-352186) (Declassified)

Deflagration rates were determined at pressures of 3 to 1000 psia for granular nitroform (HNF) tamped into glass tubes. Rates were found to be independent of tube diameter, to increase linearly with pressures above 20 psia, and to be independent of pressure at low pressures. Quenching occurred below a critical tube diameter ranging from 0.3 cm at 2 psia to 0.01 cm at 1000 psia. Deflagration wave width was about seven times the ratio for thermal diffusivity to linear deflagration width; thermal diffusivity of the unreacted material being 0.001 cm^2/sec. Chemical deflagration began with the melting of HNF, and this is attributed to the spontaneous formation of nucleate centers of pyrolysis throughout the fused material. Initially these centers are microbubbles of gaseous decomposition material products, notably NO_2, which reacts with the ambient fused material. Nitroform is unstable well below 120° C, around its melting point, and decomposes to release NO_2; and there are more of these molecules generated than destroyed by the reaction. M.W.R.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N66-16280*# National Aeronautics and Space Administration, Washington, D. C.
NACA CONFERENCE ON THE TURBOJET ENGINE FOR SUPERSONIC AIRCRAFT PROPULSION: A COMPILATION OF THE PAPERS PRESENTED
[1951] 162 p refs Conf. held Lewis Flight Propulsion Lab., Cleveland, 11 Jul. 1951
(NASA-TM-X-57165) CFSTI: HC $5.00/MF $1.00 CSCL 21E (Declassified)

CONTENTS:

1. INTRODUCTION AND COMMENTS Ia Bruce T. Lundin 5 p
2. ANALYSIS OF TURBOJET-ENGINE CHARACTERISTICS FOR SUPERSONIC PROPULSION David S. Gabriel 18 p
3. COMMENTS Ib Bruce T. Lundin 4 p
4. TURBOJET THRUST AUGMENTATION FOR SUPERSONIC PROPULSION William A. Fleming and E. William Conrad 19 p refs
5. COMMENTS Ic Bruce T. Lundin 4 p
6. SOME NOTES ON ENGINE-COMPONENT RESEARCH Robert O. Bullock 12 p
7. COMMENTS Id Bruce T. Lundin 4 p
8. TURBOJET-CONTROL SYSTEMS IN SUPERSONIC FLIGHT John C. Sanders 14 p ref
9. INTRODUCTION AND COMMENTS IIa Demarquis D. Wyatt 7 p refs
10. EFFECT OF BOUNDARY-LAYER CONTROL ON PERFORMANCE OF SIDE INLETS AT SUPERSONIC SPEEDS Edgar M. Cortright 16 p refs
11. COMMENTS IIb Demarquis D. Wyatt 6 p
12. EFFECTS OF INLET DESIGN ON PERFORMANCE OF TURBOJET-ENGINE INSTALLATIONS Roger W. Luidens and Fred T. Esenwein 14 p
13. COMMENTS IIc Demarquis D. Wyatt 7 p ref
14. THRUST CHARACTERISTICS OF AN EJECTOR PUMP H. Dean Wilsted 12 p refs

N66-16390*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GENERANT CONTROLLER DEVELOPMENT FOR THE ADVANCED LIQUID PROPULSION SYSTEM (ALPS)
W. F. Mac Glashan, Jr. 15 Nov. 1965 39 p refs
(Contract NAS7-100)
(NASA-CR-69819; JPL-TR-32-814) CFSTI: HC $2.00/MF $0.50 CSCL 21H

In the ALPS system (Advanced Liquid Propulsion System) the propellant tank is pressurized with gases generated by the decomposition of hydrazine in the gas generator. The function of the generant controller is to meter the flow of hydrazine to the gas generator so that constant pressure is maintained in the propellant tank during all firing periods regardless of variations in the rates at which propellants flow out of the tank. The generant controller is essentially a remote-sensing single-stage, spring-loaded regulator. Four controller versions were built and tested. Results of water tests that simulate expected operating conditions are recorded. Special features of these controllers, such as the diaphragm backup ring and the Belleville spring package which were developed as a result of this study, are discussed. The suitability of these special features for scalibility and for other components is pointed out. An Appendix is included which describes the function of the generant controller in the ALPS system and in the Mariner '66 system Author

N66-16455*# Rocketdyne, Canoga Park, Calif.
CHAMBER TECHNOLOGY FOR SPACE-STORABLE PROPELLANTS
E. V. Zettle, R. W. Riebling, and S. D. Clapp [1965] 55 p Presented at the AIAA Joint Propulsion Specialists Conf., Colorado Springs, 14–18 Jun. 1965
(Contract NAS7-304)
(NASA-CR-70014) CFSTI: HC $3.00/MF $0.50 CSCL 21H

Analytical and experimental studies were conducted towards establishing the technology necessary for the design of cooled thrust chambers capable of an 1800-second firing duration at a minimum c* efficiency of 95 percent, using the high performance oxidizer, oxygen difluoride, in a hydrazine-type fuel, and a thrust chamber configuration was selected that consisted of an ablative combustion chamber, a regeneratively cooled throat section, and an ablative nozzle skirt. The analyses also defined the optimum chamber pressure and mixture ratio to be used experimentally. Experimental firing tests at the 1,000 pound thrust level provided specific design criteria for a cooled thrust chamber using the selected propellant combination. Several candidate injector designs were evaluated, and a self-impinging doublet pattern was found to be the most compatible with the selected chamber cooling concept. The thrust chamber components (ablative chamber, regeneratively cooled throat, and ablative skirt) were fabricated and evaluated under sea level and simulated altitude conditions. The results indicate that all of the components can be expected to maintain their structural integrity for the required 1800-second duration while providing a c* efficiency of at least 95 percent. LS

N66-16477# Dynamic Science Corp., South Pasadena, Calif.
AFOSR 17TH CONTRACTORS' MEETING ON LIQUID PROPELLANT ROCKET AND AIR-BREATING COMBUSTION RESEARCH Compilation of Abstracts
8 Jul. 1964 34 p refs Meeting held 6–8 Jul. 1964
(Contract AF 49(638)-1151)
(AFOSR-64-0258; AD-623846) CFSTI: HC $2.00/MF $0.50

Abstracts of 26 papers are presented. TAB

N66-16547*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
VORTEX FLOW AND EROSION IN ROCKET NOZZLES DUE TO WARM-GAS INJECTION FOR THRUST VECTOR CONTROL
G. Louis Smith Washington, NASA, Feb. 1966 25 p refs
(NASA-TN-D-3241) CFSTI: HC $1.00/MF $0.50 CSCL 21H

Rocket motors with an 1800°F (1255°K) gas secondary injection for thrust vector control have been fired in three ground tests. The thrust level of the primary motors was approximately 2700 pounds (12 000 newtons), and side forces of up to 160 pounds (710 newtons) were generated by a continuous-flow gas secondary-injection system. The duration of esch firing was approximately 40 seconds. Postfiring inspection of the graphite-tape nozzles showed considerable erosion in the region of the secondary-injection ports. Comparison of

the erosion contours with pressure measurements and consideration of other flow studies indicate that the erosion is primarily due to the presence of vortices created by the gas secondary injection and that only a small amount of erosion is due to the impingement on the nozzle wall of the shock wave created by the secondary injection. From the viewpoint of erosion, the secondary-injection ports should be as far downstream as possible. Author

N66-16571*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

STATIC AND DYNAMIC CHARACTERISTICS OF CENTAUR GIMBAL SYSTEM UNDER THRUST LOAD

Robert J. Antl, David W. Vincent, and Larry D. Plews Washington, NASA, Feb. 1966 24 p refs

(NASA-TM-X-1205) CFSTI: HC $1.00/MF $0.50 CSCL 21H

Tests to determine the static and dynamic characteristics of the Centaur gimbal system under thrust load were conducted in an altitude facility. Included in the gimbal system were (1) a hydrogen-oxygen, regeneratively cooled RL10A-3 flight model engine and (2) Centaur actuators and hydraulic system. The purposes of these tests were to facilitate analyses of the system and to provide a basis for comparison with flight information. The major objectives of the test program were (1) to determine the coulomb and viscous friction of the engine gimbal block, (2) to determine the frequency response of the system, and (3) to demonstrate the structural integrity of the system under dynamic stresses. Included were the gravitational effects due to horizontal mounting of the engine, the thrust offset or misalinement vector of the engine, the facility propellant duct restraints, the transient response of the system, and the torsional loading of the gimbal block during slow movements, step changes, and cycling operation. The procedures used are outlined and the data obtained are presented in tabular and in graphical form. Author

N66-16577*# National Aeronautics and Space Administration, Washington, D. C.

PRESENT POSSIBILITIES FOR A THEORETICAL STUDY OF A SUPERSONIC EJECTOR NOZZLE [POSSIBILITIES ACTUELLES D'ETUDE THEORIQUE D'UNE TUYERE SUPERSONIQUE A DOUBLE FLUX]

Jean-Marie Hardy and Jean Delery Jan. 1966 46 p refs Transl. into ENGLISH of Repr. 288, presented at the AGARD Specialists Meeting on the Aerodynamics of Power Plant Installation, Tullahoma, Tenn., 25–28 Oct. 1965

(NASA-TT-F-9870) CFSTI: HC $2.00/MF $0.50 CSCL 21E

The plasma electron beam system as constructed for the mhd power generation experiment is described. Calculations are given on the two approaches to the introduction of the beam into the channel (window and differential pumping). A general discussion of electron beam energy loss is given as well as some calculations of expected beam performance including a theoretical beam efficiency. The results of electron beam calibration tests are given. The total electron beam assembly is discussed and the specifications for its construction are given. Author

N66-16604*# Rocketdyne, Canoga Park, Calif.

INVESTIGATION OF COOLING PROBLEMS AT HIGH CHAMBER PRESSURES Final Report, 1 Jul. 1963–31 Mar. 1965

W. S. Hines, F. W. Hoehn, W. S. Miller, A. S. Okuda, J. D. Seader et al May 1965 465 p refs

(Contract NAS8-4011)

(NASA-CR-70145; R-6199) CFSTI: HC $7.65/MF $2.25 CSCL 21H

Analytical and experimental results are presented of a continuation of the investigation to develop the engineering data and technology required to design cooling systems for liquid propellant rocket engines operating at chamber pressures from 1500 to 5000 psia and thrust levels up to 6 million pounds using liquid oxygen/hydrocarbon and liquid oxygen/liquid hydrogen as propellants. Author

N66-16748*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SOME DESIGN CONSIDERATIONS, LARGE EXPULSION BLADDERS FOR NITROGEN TETROXIDE AND HYDRAZINE

A. J. Bruman 15 Jan. 1966 38 p refs

(Contract NAS7-100)

(NASA-CR-70034; JPL-TR-32-862) CFSTI: HC $2.00/MF $0.50 CSCL 21H

The problems of chemical compatibility, permeation and folding of bladders are discussed in the context of the requirements of the Advanced Liquid Propulsion Systems (ALPS). An extensive review of the literature on subjects pertinent to these problems is summarized. Several experiments are described in which bladder materials were permeated by the fuel and oxidizer, and the meaning of the results discussed. Folded paper models illustrating some attempts to find a scheme for collapsing bladders in a controlled manner are shown; none were found suitable for the ALPS application. Three appendixes review the status of knowledge concerning oxidization resistance and permeation of polymers and the nature of Teflon. A lengthy bibliography and list of references are included. Author

N66-16920*# Litton Industries, San Carlos, Calif. Electron Tube Div.

ANALYSIS OF ELECTRON-ION MIXING IN ION ENGINES Final Report, 30 Apr. 1964–30 Jun. 1965

R. P. Wadhwa and D. F. Brauch 20 Jul. 1965 150 p refs

(Contract NAS3-5757)

(NASA-CR-54419) CFSTI: HC $4.00/MF $1.00 CSCL 21C

The two-dimensional computer program for analyzing electron-ion mixing in ion engines has been extended to new geometrical configurations. The program consists of injection of ions and electrons from appropriate locations as in an ion engine. The initial velocity distribution of the ions injected across the injection plane and the voltage variation along this plane are appropriately simulated. The injection plane is arbitrarily fixed according to convenience; on the left side of this plane lie the ion source and the other focusing electrodes while on the right side of this plane lies the electron emitter, which emits electrons according the Maxwellian distribution. Two sets of ion-beam configurations are analyzed; one corresponds to high voltage and the other to low voltage. Several values of ion-to-electron-mass-ratio are considered and a comparison is made between the withdrawn and immersed electron emitters. Different values of primary electron emission are simulated. Author

N66-16938*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

EXPERIMENTAL AND ANALYTICAL STUDIES OF CRYOGENIC PROPELLANT TANK PRESSURANT REQUIREMENTS

M. E. Nein and J. F. Thompson Washington, NASA, Feb. 1966 111 p refs

(NASA-TN-D-3177) CFSTI: HC $4.00/MF $0.75 CSCL 21H

The extensive requirement for pressurization of cryogenic propellant tanks of launch and space vehicles has

directed attention to the need for accurate methods of analysis of propellant tank thermodynamics. This paper presents the results of experimental and analytical studies of pressurization gas requirements for cryogenic liquids. Experimental results are analyzed for cylindrical and spheroidal tanks ranging in size over four orders of magnitude. A parameter study of the controllable variables of a pressurization system design illustrates their effect on ullage gas temperature. Pressurization data are provided for use in the development or checkout of analytical pressurization models and for design of pressurization systems for future launch and space vehicles. A tank pressurization computer program, using recommended coefficients, can be used to predict total and transient pressurant requirements and ullage temperature gradients within 10 percent accuracy. Author

N66-16941*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COLD-AIR PERFORMANCE EVALUATION OF SCALE MODEL OXIDIZER PUMP-DRIVE TURBINE FOR THE M-1 HYDROGEN–OXYGEN ROCKET ENGINE. I: INLET FEED-PIPE-MANIFOLD ASSEMBLY

Roy G. Stabe, David G. Evans, and Richard J. Roelke Washington, NASA, Feb. 1966 33 p refs

(NASA-TN-D-3294) CFSTI: HC $2.00/MF $0.50 CSCL 21H

A 0.45-scale model of the Model III two-stage oxidizer pump-drive turbine feedpipe-manifold-nozzle assembly for the M-1 1.5-million-pound-thrust hydrogen–oxygen engine was tested with cold air. The objectives of the tests were to determine flow conditions within the manifold and the overall performance of the feedpipe-manifold assembly. The results of the investigation indicated that a circumferential variation in nozzle-inlet total pressure of 9 percent of feedpipe total pressure existed at approximately design equivalent-inlet total- to nozzle-exit static-pressure ratio. Feedpipe-manifold assembly average total-pressure loss was 5.3 percent of inlet total pressure at design pressure ratio, which corresponds to a loss of 1.06 of the inlet dynamic pressure at a feedpipe Mach number of 0.28. The total-pressure-loss value used in the design, 3.9 percent, was based on an assumed loss of 0.5 of the inlet dynamic pressure for an assumed feedpipe Mach number of 0.35. At design equivalent-inlet total- to nozzle-exit static-pressure ratio, the measured equivalent weight flow was 10.2 percent less than the design value, of which 3.7 percent was due to a deficit in the scale-model nozzle throat area. The remaining 6.5 percent was attributed to poor flow conditions in the manifold and nozzle channels.

Author

N66-17025# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE ROLE OF KINETIC AND DIFFUSIONAL FACTORS IN THE COMBUSTION OF FUELS IN GAS-TURBINE ENGINES

V. V. Makarenkous, G. M. Panchenkov, and V. V. Vakovlevskiy 24 Nov. 1965 24 p refs Transl. into ENGLISH from the publ. "Neftekhimiya, Neftekhimicheskiye Protsessy i Neftepererabotka" Moscow, Izd-Vo "Khimiya", 1964 p 171–185

(FTD-TT-65-1015/1+2; AD-624724) CFSTI: HC $1.00/MF $0.50

The process of combustion of fuel in a gas-turbine combustion chamber may be governed, according to the fuel and the conditions in the chamber, either by physical factors, in which case it will proceed in the diffusional region, or by the rate of the chemical reaction of combustion, in which case it will proceed in the kinetic region instead. The process of combustion in the chamber can be intensified by changing the structure of the hydrocarbons composing the fuel, or by adding special compounds to the standard fuel. The additives exert an initiating action on the process of fuel combustion in cases where it is governed by the rate of the chemical reaction of combustion, and do not exert such an action when the fuel combustion process is governed instead by the atomization and vaporization of the fuel. Author (TAB)

N66-17075*# Martin Co., Denver, Colo.

STUDY OF CONTAMINATION OF LIQUID OXYGEN BY GASEOUS NITROGEN First Quarterly Report, 1 Jul.–30 Sep. 1964

Dale A. Fester, Philip J. Pizzolato, and John R. Wilde Oct. 1964 41 p refs

(Contract NAS8-11337)

(NASA-CR-70311; CR-64-51 (Issue 3)) CFSTI: HC $2.00/MF $0.50 CSCL 21H

A preliminary analytical model for the system was developed which takes into account the applicable heat and mass transfer mechanisms. An existing tank pressurization computer program is being modified to incorporate both the transfer processes in the analytical model and property data for liquid and gaseous oxygen and nitrogen over the wide range of conditions being studied. Of particular concern was the development of expressions for the transport properties of the ullage gases at pressure levels above the critical pressure. Most of the desired expressions were developed and excellent correlation with experimental data was obtained. A description of the test system, tests planned, and test procedure is presented together with the program schedule. Author

N66-17077*# Lockheed-Georgia Co., Marietta. Nuclear Lab.

STUDY OF FUNDAMENTALS OF PRESSURANT DISTRIBUTOR DESIGN Final Report

Jan. 1966 124 p

(Contract NAS8-5416)

(NASA-CR-70304; ER-8275) CFSTI: HC $4.00/MF $1.00 CSCL 21H

The results of an analytical and experimental study of pressurant distributor design fundamentals are presented. The results of expulsion tests employing gaseous nitrogen over liquid nitrogen clearly show that a means of limiting the velocity with which condensable pressurants impinge on the liquid surface is required if massive condensation is to be avoided. An analysis of turbulent free convection heat transfer is presented. Curves of Grashof number, characteristic velocity, and heat transfer coefficient are presented for gaseous hydrogen, oxygen, helium, and nitrogen all at 30 psia. A computer program used to generate some of the free convection data is included along with a sample case. An analysis of forced convection is made on the basis of the radial wall jet. Theoretical and experimental investigations of the radial wall jet have shown that the maximum velocity in the jet decreases rapidly with distance while the entrainment of secondary fluid increases quite rapidly. Rigimesh screen was found to have a much higher strength-to-weight ratio than any other material tested. Multiple radial distributors are shown to be lighter than a single distributor when total active surface area and internal pressure are the same. Author

N66-17264*# Atlantic Research Corp., Alexandria, Va.

EVALUATION OF THE MARC 7G1 AUXILIARY ROCKET MOTOR FOR USE ON THE ATLAS-CENTAUR VEHICLE Final Report, Mar.–Oct. 1965

N. C. Jasper, A. D. Mattox, and E. E. Elzufon Feb. 1966 133 p (Contract NAS3-7128-H)
(NASA-CR-54660; ARC-TR-PL-8634-00-1) CFSTI: HC $4.00/MF $1.00 CSCL 21H

The MARC 7G1, 1-KS-420 rocket motor was evaluated to determine its suitability for use as a retrograde thrust generator on the ATLAS-CENTAUR space vehicle. An igniter proof test series and a motor environmental and static firing program were conducted. The igniter was found capable of withstanding 1-ampere, 1-watt for 10 seconds without initiation. Ten motors each were fired at −30°F and 160°F, and at simulated altitudes above 100,000 feet. Measured motor ballistic data were within design objectives. Impulse reproducibility was excellent, particularly at the higher temperature. Although burning reproducibly, nine of the ten −30°F motors exhibited abnormal ballistics due to excessive strain of the propellant web during startup pressurization. Design changes eliminating this problem proved successful in two additional tests at −30°F. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N66-16273 Joint Publications Research Service, Washington, D. C.
ULTRAVIOLET RADIATION ON THE TERRITORY OF CENTRAL ASIA
M. V. Sitnikova *In its* Heliotechnol. 3 Jan. 1966 p 31–33 refs (See N66-16266 07-34) CFSTI: $3.00

The distribution of ultraviolet radiation on central Asia is briefly considered. Observed differences in radiation levels between citys, plains, and mountains, are discussed, and reasons for these differences are postulated. Tabulations are included for the intensity of direct solar radiation in the 2900 to 3800 A region recorded at various stations. C.T.C.

N66-16276 Joint Publications Research Service, Washington, D. C.
STUDY OF SOLAR RADIATION FALLING ON SCHOOL BUILDINGS
T. I. Shapalova *In its* Heliotechnol. 3 Jan. 1966 p 44–48 refs (See N66-16266 07-34) CFSTI: $3.00

Presented are results of a study aimed at determining the amount of solar radiant energy received by school buildings in the city of Ferghana in their actual location on the terrain and comparing it with the amount they would have received with their principal fronts facing north and south. Studies were performed on models exposed to simulated solar radiation as well as actual school buildings. Formulas for computing the amount of radiation getting to the building are given. Test results confirm that orientation of a building with its principal fronts to the north and south gives the best natural light; as a result, the building receives less solar energy in the summer and more in the winter. M.R.W.

N66-16382*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
A CORRELATION OF OUTER RADIATION ZONE ELECTRONS (E_e ~1 MeV) WITH THE SOLAR ACTIVITY CYCLE
L. A. Frank and J. A. Van Allen Jan. 1966 17 p refs *Its* Rept.-66-1
(Contracts NsG-233-62; Nonr-1509(06))
(NASA-CR-69873) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A comparison of observations with several earth satellites reveals that the inner edge of the outer radiation zone of electron $E_e > 1.6$ MeV intensities has moved outward from $L = 2.2$ in mid 1958 to $L = 3.0$ in late 1964. This outward motion of the outer radiation zone occurs during the declining phase of solar activity cycle 19 and strongly suggests a systematic change of the average value of one or more of the solar wind parameters over this time period. Author

N66-16405*# Texas Western Coll., El Paso. Schellenger Research Labs.
ANALYSIS OF DESIGN CRITERIA FOR A RADIO FREQUENCY PROTON EVENT WARNING SYSTEM OPERATING IN THE FREQUENCY RANGE 1000–3750 MEGACYCLES PER SECOND
Alexis Shlanta and Michael D. Mc Anally Sep. 1965 50 p refs
(Grant NGR-44-020-001)
(NASA-CR-69853) CFSTI: HC $2.00/MF $0.50 CSCL 20H

A statistical analysis has been made on solar radio emission associated with large proton events and solar radio outbursts associated with no proton events and small proton events for the frequency range 1000–3750 mc/s. Specific criteria have been established for this frequency range. Furthermore, investigations have been made into false alarms and frequency combinations. The results of this analysis can serve as the basic design criteria for an electronic system that may provide a warning for large solar proton events. This criteria will hold for any frequency in the range 1000–3750 mc/s. Such a warning system would reduce the corpuscular radiation hazard to future space flights. Author

N66-16480# Joint Publications Research Service, Washington, D. C.
COSMIC RAY RESEARCH OF THE MUSALA MOUNTAIN RESEARCH STATION
Tsvetan Tsvetkov 21 Dec. 1965 12 p refs Transl. into ENGLISH from Priroda (Moscow), no. 11, Nov. 1965 p 76–79 (JPRS-33446; TT-65-34020) CFSTI: $1.00

An article describing the cosmic radiation research programs and meteorological investigations conducted at the Musala cosmic ray station by the Physics Institute of the Academy of Sciences of Bulgaria is presented. A general description of the facility and the instruments and equipment used for the analysis and measurement of cosmic radiation is also included. M.R.W.

N66-16495# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
SHIELDING ANALYSIS OF 1956–1961 SOLAR PROTON EVENT DATA
J. W. Haffner 15 Jul. 1964 39 p refs
(SID-64-1295)

Since it is the large solar particle events which constitute the major high energy radiation hazard to extended space travel, an analytical study of the characteristics of the protons observed during these events was carried out. By mathematically

fitting the statistically average proton fluxes of such large events, reasonable time and energy behaviors were found. Combining this with a flux to dose conversion function and making use of two almost compensating assumptions yielded an accurate attenuation kernel useful for thickness 0–30 gm/cm^2 of any material. Author

N66-16666# Smithsonian Astrophysical Observatory, Cambridge, Mass.
RADIATION SPIKES IN HII REGIONS
Thornton L. Page 14 Dec. 1965 21 p refs
(SAO Special Rept.-196)

Gravitational focusing of radiation passing a dense mass produces a long thin region of high flux density from a single bright source. If the dark mass is at rest in an HII region, a bright spike should appear behind it. The dimensions of such spikes have been calculated for blue stars, novae, and supernovae in hydrogen clouds of various densities for masses of stellar and galactic sizes. The effects of relative motions are estimated. It is found to be barely possible that HII spikes will reveal intergalactic hydrogen, or collapsed galaxies, or other unobservable masses, under favorable circumstances. Author

N66-16697*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
FURTHER REMARKS ON THE ABSENCE OF A VERY EXTENDED MAGNETOSPHERIC TAIL
J. A. Van Allen [1965] 24 p refs Prepared for JPL *Its* Rept.-65-40
(Contracts NAS7-100; JPL-950613)
(NASA-CR-70047) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Data from the Mars-bound spacecraft Mariner 4 are used to give answers to the following questions: (1) To what anti-solar distance in the earth's magnetospheric tail are there detectable intensities of super-thermal electrons? (2) Is the vector magnetic field due to the tail observable in the presence of the interplanetary magnetic field of the solar wind, the latter being the physical agent for the production of the tail? (3) Is the arrival of low energy ($\leq$5 MeV) solar protons at the top of earth's atmosphere during the early phase of a PCA event preferentially in the auroral zones (geomagnetic latitude ~68°) and not within the polar caps? (4) Does the effective geomagnetic cut-off for solar protons vanish at the same latitude for all energies less than ~40 MeV and with a "sharpness" in latitude corresponding to a gyro-radius? M.R.W.

N66-16716*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy
OBSERVATION OF $\leq$ 500 KeV PROTONS IN INTERPLANETARY SPACE WITH MARINER IV
S. M. Krimigis and J. A. Van Allen Dec. 1965 18 p refs *Its* Rept.-65-45
(Grant NsG-233)
(NASA-CR-70022) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Protons of kinetic energy E_p approximately 500 keV observed by a detector complement aboard the Mariner IV spacecraft during a ten month period of interplanetary flight are reported. The solid state detector has two discrimination levels set to count protons in the energy ranges $0.50 \leq E_p \leq 11$ MeV (channel D_1) and $0.88 \leq E_p \leq 4$ MeV (channel D_2). Both channels are insensitive to galactic cosmic rays and to electrons of any energy in the intensities found to be present by the Geiger tubes during the flight. Graphical recordings of the daily averages of the counting rates of channels D_1 and D_2 during the ten months of flight are presented; and a list of 20 resolvable proton events having clear statistical significance is given. Preliminary remarks regarding the data are stated. L.S.

N66-16807# Joint Publications Research Service, Washington, D. C.
RESEARCH ON SOLAR ACTIVITIES
Ch'en Piao *In its* Transls. on Communist China's Sci. and Technol. 17 Jan. 1966 p 12–19 refs (See N66-16806 07-34) CFSTI: $6.00

Recent analyses of the strength of solar activities according to fluctuation effects of sun spots and measurements of the sun's ordering activities are reviewed. Various calculations on solar activity cycles, their independence, and their similarity are briefly outlined. G.G.

N66-16935*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR CYCLE EFFECTS ON INNER ZONE PROTONS
R. C. Blanchard and W. N. Hess Washington, NASA, Feb. 1966 43 p refs
(NASA-TN-D-3086) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Solar cycle variations of the proton population of the inner radiation belt are calculated in this report. The analysis includes proton energies from 10 to 700 Mev, field lines from 1.2 to 1.6 earth radii, and appropriate values of field strength. An averaged atmospheric model is constructed in terms of B (flux density in gauss) and L (earth radii) coordinates which represents the average proton number density that trapped particles would encounter. The time dependence of the atmospheric model is constructed for the current cycle using averaged information of the 10.7-cm solar flux of the recent past. Proton flux spectra for solar minimum and solar maximum are calculated from the particle conservation equation. Transient proton spectra and time histories are presented. The results indicate that in the region of B-L space corresponding to minimum altitudes of 300 to 800 km, the proton flux is changed appreciably from solar maximum to solar minimum where solar minimum is the larger. Calculations indicate a change in the nature of the proton spectra where the spectra become peaked at some energy level depending on the time in the cycle and position in space. Author

N66-16975*# State Univ. of Iowa, Iowa City.
SOME GENERAL ASPECTS OF GEOMAGNETICALLY TRAPPED RADIATION
J. A. Van Allen Jan. 1966 34 p refs Presented at the Advanced Study Inst. on Radiation Trapped in the Earth's Magnetic Field, Bergen, Norway, 16 Aug.–3 Sep. 1965 *Its* Rept.-66-2
(Grant NsG-233)
(NASA-CR-70185) CFSTI: HC $2.00/MF $0.50 CSCL 20H

This paper provides a sketch of the physical principles of radiation belts and an abridged summary of the present state of knowledge of the geomagnetically trapped radiation. As such, it is intended as an introduction to detailed papers on specific topics which constitute the remainder of the Bergen conference. Author

N66-17014# Michigan Univ., Ann Arbor. Dept. of Physics.
THE USE OF COSMIC RAYS TO STUDY PHYSICS IN THE RANGE 100–1000 GeV Technical Report No. 21
Lawrence W. Jones Oct. 1965 15 p refs Presented at the 5th Intern. Conf. on High Energy Accelerators, Frascati, Italy, Sep. 1965
(Contract Nonr-1224(23))
(Rept.-03106-21-T; AD-624518) CFSTI: HC $1.00/MF $0.50

The extent to which cosmic rays might permit some quantitative study of strong interactions in the 100 to 1000 GeV range was reexamined, and the design of a mountain top cosmic ray experimental facility employing spark chambers, large magnets, and a liquid hydrogen target was explored. The following criteria were formulated: (1) A liquid hydrogen target should be used to insure reactions on protons. (2) The interaction data should be above energies available with machines, with the statistics comparable to a typical bubble chamber experiment. (3) Both incoming and outgoing particles from a reaction should be momentum analyzed to a few percent or better, and angles should be well resolved for studying invariant masses, momentum transfers, etc., with reasonable precision. (4) It would be desirable to distinguish positive pions from protons in the incident beam. It is pointed out that data would consist of film from several cameras and pulse heights and/or timing information from about 2000 separate counter channels on magnetic tape. The study indicated that this experiment can be operational in four years at a cost of about $15 million. M.G.J.

N66-17058*# International Business Machines Corp., Rockville, Md. Federal Systems Div.

ORL EXPERIMENT PROGRAM, VOLUME B. PART XIII: PHYSICAL SCIENCES

21 Feb. 1966 183 p refs

(Contract NASw-1215)

(NASA-CR-70355) CFSTI: HC $4.00/MF $1.25 CSCL 03B

In synthesizing an experiment program for Orbital Research Laboratories (ORLs), an illustration is given of the application of the synthesis approach to the physical sciences scientific and technical area. Consideration is given to the identification of selected knowledge requirements and the derivation of experiment requirements. These include equipment functional and supporting reseach requirements, and prospective orbital activities. Appendices include illustrations and identifications of selected knowledge requirements, relativity experiments using an artificial earth satellite, and indicative phenomena and functional requirements. C.T.C.

N66-17186*# National Aeronautics and Space Administration, Washington, D. C.

INTENSITY VARIATIONS OF COSMIC RAYS

A. I. Kuz'min, ed. Feb. 1966 222 p refs Transl. into ENGLISH of the book "Variatsii Intensivnosti Kosmicheskikh Luchey" Moscow, Akad. Nauk SSSR, Sibirsk. Otd., Ser. Fiz., Vypusk 4, 1962

(NASA-TT-F-183) CFSTI: HC $6.00/MF $1.25 CSCL 20H

Journal ariticles on experimental methods and techniques, meteorological effects in the intensity of cosmic rays, and main properties and nature of variations in the intensity of cosmic rays are presented. For individual titles see N66-17187–N66-17213.

N66-17187* National Aeronautics and Space Administration, Washington, D. C.

AIRPLANE MEASUREMENTS OF SLOW COSMIC-RAY NEUTRONS

N. L. Grigorov, V. D. Sokolov, and V. F. Lyutenko *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 1–7 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Described is an integrating ionization chamber for measurements of slow cosmic ray neutrons. One part of the chamber is filled with boron trifluoride gas that reacts with lithium and thus produces an ionization current, and the second part is used to compensate the current so that the ionization due to the B^{10} (n,α) Li^7 reaction products alone can be determined. Charges accumulated on the collecting electrodes due to the neutron component of the ionization current are then converted into a voltage pulse. The apparatus was tested in 5 airplane flights and the instrument readings were recorded at 60-second intervals. It was found that the mean neutron absorption thickness for the atmospheric layer between 600 to 700 mb was 169 ± 6 g/cm^2. G.G.

N66-17188* National Aeronautics and Space Administration, Washington, D. C.

COUNTING APPARATUS FOR THE INVESTIGATION OF THE NEUTRON COMPONENT OF COSMIC RAYS IN THE ATMOSPHERE

V. D. Sokolov and I. N. Kapustin *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 8–11 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Design and working principles of a boron trifluoride filled proportional neutron detector for balloon measurements of the density of slow cosmic ray neutrons are presented. This device displays a much greater amplitude of the ionization pulse due to the decay products from of the B^{10} (n,α) Li^7 reaction than the amplitude due to relativistic particles by utilizing two detectors filled with different concentrations of B^{10} gas. G.G.

N66-17192* National Aeronautics and Space Administration, Washington, D. C.

UNDERGROUND ANGULAR DISTRIBUTION OF COSMIC-RAY INTENSITY AT DEPTHS OF 0–60 METERS OF WATER EQUIVALENT

A. I. Kuz'min, G. F. Krymskiy, and G. V. Skripin *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 24–30 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Continuously operating triple-coincidence counter telescopes at depths of 0, 7, 20, and 60 m of water equivalent below ground level, and at angles of 0, 30, and 60° to the zenith were used to determine the effective value of the exponent in the angular distribution of cosmic ray intensities at above reading levels. It was shown that as the depth of recording increases, the exponent of the angular velocity increases as well and exceeds the limit of error. This dependence corresponds to the intensity versus depth curve for μ-mesons. Obtained exponent and vertical intensity values for all four levels are presented in a table. G.G.

N66-17195* National Aeronautics and Space Administration, Washington, D. C.

OPERATION OF SNM-8 COUNTERS AT VOLTAGES UP TO 3 kV

A. V. Sergeyev and A. A. Luzov *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 47–51 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Two slow neutron proportional counters were studied over an active period of three months in order to determine the maximum value at which the devices will operate as proportional counters. Observed pulse amplitudes were plotted as linear functions of the applied voltage across each counter, and amplitude characteristics were recorded both with a Po-Be neutron source and with a Co^{60} γ-source. The large difference between neutron amplitudes and γ-ray amplitudes was used to identify the neutron counting rate. It was found that the logarithm of the pulse amplitude due to neutrons was a linear function of the voltage across the counter; the amplitude was 80 mV at 3000 V. G.G.

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N66-17196* National Aeronautics and Space Administration, Washington, D. C.

RESULTS OF A STUDY OF THE QUANTITY γ_{eff} IN THE DIFFERENTIAL π-MESON PRODUCTION SPECTRUM

A. A. Danilov, G. F. Krymskiy, and V. A. Filippov *In its* Intensity Variations in Cosmic Rays Feb. 1966 p 52–62 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Investigated were the discrepancy between cosmic ray intensitites obtained by a meson semi-cubic telescope and by an ionization chamber, and the effect of magnetic storms, 27-day recurrences, and diurnal variations on both. Calculations using the temperature-coefficient density function for a parallel μ-meson beam of an S-2 ionization chamber and using corresponding properties for a semi-cubic telescope found the differences in the directional properties of these instruments. G.G.

N66-17197* National Aeronautics and Space Administration, Washington, D. C.

SEASONAL EFFECT IN THE INTENSITY OF COSMIC RAYS DEDUCED FROM MEASUREMENTS IN THE STRATOSPHERE

Yu. G. Shafter and V. D. Sokolov *In its* Intensity Variations in Cosmic Rays Feb. 1966 p 64–64 ref (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

The mean monthly value of cosmic ray intensity as measured by counter telescope at different atmospheric pressure levels was used to estimate seasonal effects in the cosmic ray intensity. The amplitude of the seasonal variation reached 8% at the 300 mb level, and decreased with height to approximately 6% at the 60 mb level. This large amplitude indicated the existence of low-energy μ-mesons and shower processes due to changes in atmospheric density. Thus, in summer, the increase in the geometrical height of the atmosphere gives rise to the decay of low-energy μ-mesons. The opposite situation occurs in winter. G.G.

N66-17198* National Aeronautics and Space Administration, Washington, D. C.

A METHOD OF ALLOWING FOR GEOMETRIC EFFECTS IN THE EAS FREQUENCY VARIATIONS NEAR SEA LEVEL

D. D. Krasil'nikov *In its* Intensity Variations in Cosmic Rays Feb. 1966 p 65–71 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Various methods for estimating the distortions in the extensive air shower (EAS) frequencies by geometric effects are discussed and evaluated. An analysis based on the variation of the shower function with the height of the atmospheric layer at a constant EAS size spectrum is developed that uses an altitude variation of the spatial distribution to characterize the function relating to atmospheric density. G.G.

N66-17199* National Aeronautics and Space Administration, Washington, D. C.

ON THE PROBLEM OF MULTIPLICITY

G. F. Krymskiy *In its* Intensity Variations in Cosmic Rays Feb. 1966 p 72–77 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

The relation between secondary components and the primary flux of the energy spectrum of primary cosmic-ray variations was studied. A model for the contribution of different energies to the primary spectrum was formed by assuming that the coefficient for the elasticity was 0.5, the recoil nucleon carried off a negligible fraction of energy, and only nucleons gave rise to interactions for the recording of μ-mesons. Estimates carried out for this model showed that as the number of interactions produced by primary particles increased, the average energy of the secondary particles decreased. G.G.

N66-17200* National Aeronautics and Space Administration, Washington, D. C.

THE CONTRIBUTION OF THE UPPER ATMOSPHERE TO SMALL EFFECTS IN THE HARD COMPONENT OF COSMIC RAYS DURING CHROMOSPHERIC FLARES

A. I. Kuz'min *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 78–83 refs (See N66-07186 07-29) CFSTI: HC $6.00/MF $1.25

The importance of the upper atmosphere in the effect of small solar flares is estimated using the data obtained as a result of continuous recording of the hard component of cosmic rays by ground-level and underground apparatus during 1957 to 1959. It was concluded that no appreciable changes in the average temperature of the ozonosphere are observed during shortwave radio fadeouts. The maximum average changes in the temperature of the ozonosphere in 1957 to 1959 during small chromospheric flares did not exceed 5 degrees. In 1957 to 1959 no appreciable changes were observed in the intensity of cosmic rays at the earth's surface during small chromospheric flares. E.E.B.

N66-17201* National Aeronautics and Space Administration, Washington, D. C.

UNDERGROUND VARIATIONS IN THE INTENSITY OF COSMIC RAYS IN 1957–1959

A. I. Kuz'min and G. V. Skripin *In its* Intensity Variations in Cosmic Rays Feb. 1966 p 84–105 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Underground cosmic-ray measurements from the period 1957 to 1959 obtained by an array of counter telescopes at different levels within a special shaft, were analyzed for the average energies of primary particles between 40 and 200 BeV. Statistical accuracy of each component at every depth was calculated from the values of all the identical double telescopes. Intensities of the hard component at the earth's surface and at 7, 20 and 60 m water equivalent were in agreement with a low meson scheme for the generation of hard components in the atmosphere. Amplitudes for a 27-day variation decreased in intensity during magnetic storms within a wide primary energy range. G.G.

N66-17202* National Aeronautics and Space Administration, Washington, D. C.

MAIN PROPERTIES OF SOLAR DIURNAL VARIATIONS FROM DIRECTIONAL COSMIC-RAY MEASUREMENTS

G. V. Skripin *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 106–116 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Directional measurements of cosmic-ray diurnal variations were carried out by counter apparatus at ground level and underground at depths of 7, 20, and 60 m water equivalent. Data showed that the source of the diurnal variation was located at 80° left of the earth-sun line in the plane of the ecliptic. A maximum amplitude of diurnal variation at all levels was indicated by telescopes pointing south, while the smallest amplitude was indicated by telescopes pointing north. Calculations on strength distribution for the diurnal variations confirmed the theory that solar corpuscular streams carrying frozen-in regular magnetic fields are the source of the average solar diurnal variation. G.G.

N66-17203* National Aeronautics and Space Administration, Washington, D. C.

SOME MAIN PROPERTIES OF DISTURBED DIURNAL VARIATIONS IN THE INTENSITY OF COSMIC RAYS

A. I. Kuz'min and G. V. Skripin *In its* Intensity Variations in Cosmic Rays Feb. 1966 p 117–132 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Cosmic-ray intensity data for 1957 to 1959 were analyzed to determine the main properties of disturbed diurnal variations and to compare experimental results quantitatively with theoretical predictions. A considerable change in diurnal variations of cosmic rays was found during magnetic disturbances with a maximum recorded at all depths by telescopes pointing in a direction parallel to the plane of the ecliptic. Main characteristics of the disturbed diurnal variations showed good agreement with theoretical values and were explained by the effects of electric and magnetic fields of solar corpuscular streams reaching the earth. G.G.

N66-17204* National Aeronautics and Space Administration, Washington, D. C.

ON THE COEFFICIENT OF ABSORPTION OF COSMIC RAYS RESPONSIBLE FOR SOLAR DIURNAL VARIATIONS

A. I. Kuz'min and G. V. Skripin *In its* Intensity Variations in Cosmic Rays Feb. 1966 p 133–140 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Diurnal variations of the μ-meson component of cosmic-rays at ground level were compared with identical ionization chamber measurements under different amounts of matter to obtain their absorption coefficients. The μ-mesons which exhibited the diurnal variations during years of minimum solar activity had an absorption coefficient which was higher by a factor of 2 than the absorption coefficient for μ-mesons undergoing the same variations during very high solar activity. This change in absorption coefficient was attributed to either a change in the threshold energy, or a sharp change in the properties of the source of diurnal variations. G.G.

N66-17205* National Aeronautics and Space Administration, Washington, D. C.

LUNAR DIURNAL VARIATIONS IN COSMIC RAYS

G. F. Krymskiy *In its* Intensity Variations in Cosmic Rays Feb. 1966 p 141–144 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Neutron monitor and ionization chamber data of cosmic ray recordings between September 1957 and August 1958 were analyzed for the presence of a lunar diurnal variation. Resulting mean monthly values of the lunar diurnal variation were subjected to a Fourier analysis and results are presented in a table. It was shown that neutron and hard components of cosmic-rays exhibited variations with a period equal to one half of the lunar day at amplitudes of 0.0% and 0.015%, respectively. A variation was also established with a period equal to the lunar day and a tendency to a constant phase. G.G.

N66-17206* National Aeronautics and Space Administration, Washington, D.C.

"DAY-NIGHT" EFFECT IN THE COSMIC RAY INTENSITY FROM MEASUREMENTS IN THE STRATOSPHERE

Yu G. Shafer *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 145–147 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Results from more than 20 night and day flights to measure the diurnal effects in stratospheric cosmic ray intensities were analyzed. Obtained averages showed that the cosmic ray intensity at night exceeded that of the day time by 2%. This relatively small diurnal variation supports the theory of a cut-off at low energies for solar diurnal variations. G.G.

N66-17207* National Aeronautics and Space Administration, Washington, D. C.

ELECTROMAGNETIC CONDITIONS IN THE EARTH'S NEIGHBORHOOD ON MAY 10–24, 1959

A. I. Kuz'min and G. V. Skripin *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 148–158 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Described are the electromagnetic conditions in the earth's neighborhood during the major magnetic storm of May 11, 1959. Cosmic-ray meson measurements at ground level and at various depths underground for the period between May 8 to May 24 were evaluated for their amplitude intensity, duration of storm, onset of decrease and recovery, and the time of the recovery of intensity. Cosmic-ray values were in agreement with the lateral capture of the earth by the electromagnetic stream that carried a frozen-in magnetic field of the order of 10^{-5} or with a radial velocity of 5×10^8 cm/sec. G.G.

N66-17208* National Aeronautics and Space Administration, Washington, D. C.

11-YEAR VARIATIONS IN THE INTENSITY OF COSMIC RAYS

N. P. Chirkov, V. A. Filippov, and G. V. Shafer *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 159–171 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

The 11-year variations in cosmic-ray intensity between the 1954 solar activity minimum and the 1958 to 1959 maximum were studied. Hard component intensity data from ionization chambers and neutron intensity data from standard neutron monitors were evaluated statistically for their seasonal variations, intensities and Forbush-type effects. Results showed that the cosmic ray-intensity fell by 3.2% ±0.1% between 1954 and 1958, concurrent with a secular cooling of about 2°C of the earth's atmosphere. The neutron component minimum was delayed by 5 months and the hard component minimum by 2 to 3 months relative to the solar activity maximum in October, 1957. G.G.

N66-17209* National Aeronautics and Space Administration, Washington, D. C.

COSMIC-RAY INTENSITY BURST OF MAY 4, 1960

A. I. Kuz'min, G. V. Kuklin, A. V. Sergeyev, G. V. Skripin, N. P. Chirkov et al *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 172–178 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

A considerable increase in cosmic-ray intensity as recorded on May 4, 1960 by standard neutron monitors distributed over the Northern Hemisphere was analyzed to determine the energy spectrum of the variations and to obtain accurate values for the onset and maximum of the burst. The cosmic ray bursts were preceded by a solar flare with rapid developments of loop prominences in the coronal region above a sunspot group. A delay in the onset of the burst, relative to the ionospheric disturbance, was attributed first to the arrival of shortwave radiation at the earth, and, somewhat later, the arrival of the particle stream. G.G.

N66-17210* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF MAGNETIC STORMS IN THE INTENSITY OF COSMIC RAYS ACCORDING TO MEASUREMENTS IN THE STRATOSPHERE

Yu G. Shafer and V. D. Sokolov *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 179–183 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

An attempt was made to determine the effects of magnetic storms on cosmic ray intensity. Preliminary results of the data analysis show that effective storms were accompanied by a considerable reduction in intensity. Further, for a series of storms in July, 1959, comparisons of storm effects in the stratosphere and on the ground indicate that mostly primary particles with energies from 20 to 30 BeV were affected. Graphs and tables are included. D.T.

N66-17211* National Aeronautics and Space Administration, Washington, D. C.

COMPOSITE GEOPHYSICAL OBSERVATIONS AT YAK-UTSK DURING JULY, 1959

A. I. Kuz'min, G. V. Shafer, Yu. G. Shafer, D. D. Krasil'nikov, G. F. Krymskiy et al *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 184–205 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

In the study of the electromagnetic properties of solar flares, a description is given of three magnetic storms which occurred in July, 1959, and their effects on the geomagnetic field, the ionosphere, auroras, and cosmic ray intensity. Analyses, graphs and tables of geomagnetic, ionospheric, and cosmic ray data are included. Next, a determination is made of the energy characteristics of cosmic ray variations. Finally, an attempt is made to show that there exists an effective relation between the solar phenomenon and magnetic storms. D.T.

N66-17213* National Aeronautics and Space Administration, Washington, D. C.

SOME DECREASES IN COSMIC-RAY INTENSITY

G. V. Skripin and G. V. Shafer *In its* Intensity Variations of Cosmic Rays Feb. 1966 p 208–214 refs (See N66-17186 07-29) CFSTI: HC $6.00/MF $1.25

Cosmic-ray intensity decreases are reported which preceeded the magnetic storms of October 21, 1957 and July 8, 1958. Moreover, a description is given of an event on May 9–10, 1958 when all the stations in the world network observed a cosmic-ray intensity decrease 2–3 days prior to the onset of the magnetic storm. The analysis covered μ-meson and neutron cosmic-ray data obtained at various stations at sea level, and also composite ground-level and underground cosmic-ray measurements. Author

N66-17230*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

THE MOTION OF TRAPPED PARTICLES IN A DISTORTED FIELD

Gilbert D. Mead Oct. 1965 25 p refs Presented at Advanced Study Inst. on Radiation Trapped in the Earth's Magnetic Field, Bergen, Aug. 1965

(NASA-TM-X-55391; X-640-65-434) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The motion of charged particles in a geomagnetic field distorted by the solar wind is examined, using adiabatic theory. It is shown that the drift motion of particles trapped on high L-shells depends strongly on their equatorial pitch angle. Those mirroring near the equator move in on the night side, while those mirroring at low altitudes move out, thus producing a significant splitting of the L-shell with pitch angle. One consequence is that the very high latitude lines on the day side may contain trapped particles near the equator, but none near the ends of the lines. The opening up of field lines in the geomagnetic tail may be the controlling factor governing the high-latitude limit of trapping on both the day side and the night side. Author

N66-17238*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

THE MULTIPLY-CHARGED PRIMARY COSMIC RADIATION AT SOLAR MINIMUM, 1965

V. K. Balasubrahmanyan, D. E. Hagge, G. H. Ludwig, and F. B. Mc Donald Nov. 1965 30 p refs

(NASA-TM-X-55403; X-611-65-480) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The primary cosmic ray charge and energy spectra have been obtained for helium through neon during the recent period when solar modulation effects were at a minimum. These spectra represent a synthesis of preliminary experimental results from cosmic ray experiments flown on OGO-I, IMP-III and high latitude Skyhook balloon flights. The He energy spectrum is given from 35 to 750 Mev/nucleon. The energy spectra for Lithium–Oxygen covers the interval ~40–1200 Mev/nucleon. Integral flux values > 1200 Mev are also obtained for all components. L/M ratios of 0.29 ±.07 at 100 Mev/nucleon and 0.30 ±.03 above 600 Mev/nucleon are found. The C/He ratio of 0.023 ±.005 at 100 Mev/nucleon is significantly less than the same integral ratio of 0.036 ±.004 above 600 Mev/nucleon, indicating energy dependent ionization and spallation losses during propagation through the interstellar gas under the assumption of similar source spectra. Author

N66-17243*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

PLASMA PRESSURES IN THE MAGNETOSPHERE

M. P. Wakada Dec. 1965 22 p refs

(NASA-TM-X-55411; X-641-65-507) CFSTI: HC $1.00/MF $0.50 CSCL 20H

By using a model that has the solar wind as the source for protons in the outer radiation belt, plasma energy densities near the equatorial magnetopause have been estimated to be comparable to the magnetic field energy density there. The inflation of the geomagnetic field due to the presence of this plasma is discussed. The presence of high energy density plasma near the magnetic equator in the tail suggests that closed field lines exist at times out to 17 earth radii. Author

N66-17248*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SOURCE OF OUTER ZONE PROTONS

W. N. Hess Sep. 1965 37 p refs Presented at the Advanced Study Inst. on Radiation Trapped in the Earth's Magnetic Field, Bergen, 16 Aug.–3 Sep. 1965

(NASA-TM-X-55375; X-640-65-389) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Experimental proton flux and spectral data in the L=2 to 5 range in the outer radiation belt were inspected. The equatorial pitch angle α_0 considered is near 90°. Changes in both the energy and equatorial pitch angle are calculated for cases where the first and second adiabatic invariants of the trapped particles are maintained during motion in L space. The way the flux of particles varies with motion in the L region are also calculated. Reasonable agreement was found between measured fluxes and transformed fluxes for equatorial particles. In addition, off-equator particles having $\alpha_0 \neq 90°$ were also examined. Inspection of the transformed flux curves indicates that near the equator the agreement of the measured fluxes and transformed fluxes is quite good where direct comparison can be made, going off-equator up to proton energies of a few MeV. For higher energies, the region of

agreement is quite small; and for locations well off-equator there is a decided discrepancy between the measured fluxes and transformed fluxes. The measured fluxes are consistently higher. Other particle experiments are also discussed. L.S.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N66-16166*# Minnesota Univ., Minneapolis. "TYCHO" Study Group.
REPORT OF AUGUST 1965 "TYCHO" MEETING
Aug. 1965 396 p refs Meeting held in Boulder, Colo.
(Contract NSR-24-005-047)
(NASA-CR-69878; TG-1) CFSTI: HC $7.00/MF $2.00 CSCL 03B

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N66-16167* Princeton Univ., N. J.
INTERNAL TEMPERATURES OF THE MOON
Robert A. Phinney and Don Lynn Anderson (Calif. Inst. of Tech.) *In* Minn. Univ. Rept. of Aug. 1965 "TYCHO" Meeting Aug. 1965 71 p refs (See N66-16166 07-30) CFSTI: HC $7.00/MF $2.00
(TG-2)

Thermal history calculations are made to investigate melting in the interior of the Moon and volcanism. Various models are used to predict the start of melting, and it shown that differentiation and volcanism, accompanying this melting, will tend to redistribute both heat and matter. After differentiation, the increased concentration of radioactivity makes the near surface of the Moon heat up very rapidly. Volcanism probably occurred two to three billion years ago, following the differentiation. The Moon is probably a differentiated body, but without a heavy core; and the internal layering is probably silicic. It is concluded that lava and/or ash flow is probably present on the lunar surface. Mars, on the other hand, is shown to be an undifferentiated body which will not melt. Evidence points to the possibility of considerable seismicity on the Moon, and specific first generation experiments are suggested to determine if this condition will be a threat to manned space missions. M.W.R.

N66-16168* Minnesota Univ., Minneapolis.
EROSION OF THE LUNAR SURFACE BY METEOR IMPACT
Robert J. Collins *In its* Rept. of Aug. 1965 "TYCHO" Meeting Aug. 1965 16 p refs (See N66-16166 07-30) CFSTI: HC $7.00/MF $2.00
(TG-3)

The bombardment of the lunar surface by meteorites will produce craters. The flux of these meteors on the Earth is reported for the range 10^{8} to 10^{-14} grams. Correlation of this flux with the experimental effects produced by the impact of hypervelocity particles with solid surfaces allows a prediction of the impact produced crater distribution on the lunar surface. The present report shows that in craters of small size ($d \leq 300$ m) steady state has been reached in coverage. It is suggested that the observed crater distribution is primarily the result of meteor infall. Author

N66-16169* Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR STUDIES OF THE MOON
John V. Evans *In* Minn. Univ. Rept. of Aug. 1965 "TYCHO" Meeting Aug. 1965 81 p refs (See N66-16166 07-30) CFSTI: HC $7.00/MF $2.00
(TG-4)

Radar experiments are described which shed light on the composition of the moon. Based on a two-layer model, it appears that at normal incidence some 60% of the echo energy is reflected from within the surface, presumably at points where the density increases rapidly with depth. The dielectric constant of the upper layer is considered to be not less than 1.8, which implies a porosity range between 70 and 90% depending upon the nature of the material. It is concluded that the depth of the upper layer must be greater than 23 cm, but also irregular. Under the assumption that there is only a single reflecting layer within the surface, the base layer must be highly compacted if not solid; and dielectric constant of this layer is estimated to be between 4.5 and 5.0. Range doppler mapping with controlled polarization at a number of wavelengths is considered to be the only ground-based technique for further exploring the base layer of the moon. M.W.R.

N66-16170* Cornell Univ., Ithaca, N. Y.
PART I: THE CASE AGAINST VOLCANISM. PART II: A RECOMMENDATION FOR PHOTOGRAPHY ON THE MOON'S SURFACE
Thomas Gold *In* Minn. Univ. Rept. of Aug. 1965 "TYCHO" Meeting Aug. 1965 20 p refs (See N66-16166 07-30) CFSTI: HC $7.00/MF $2.00
(TG-5)

The presence of ice below and the depth of the dust layer above the lunar surface is discussed in a paper which presents the case against volcanism on the Moon. Since the mean density of the Moon is estimated to be slightly less than the uncompressed density of the Earth, it is speculated that the Moon was formed at a lower temperature and from a greater proportion of more volatile light elements, with water among the most plausible constituents. The water does not reach the lunar surface, which is usually well below freezing, because any water going upward is frozen in surface cracks. It is considered well worth investigating, however, whether the small quantities of water vapor escaping from the Moon might correspond to the slight evaporation from the top of the underlaying ice. There are numerous convex structures on the Moon's surface, both inside craters and around edges of maria; these resemble terrestrial pingos, perma-frost ice lenses in the ground which heave up the underlying material. It is speculated that deposits of dust layers in some parts of the lunar surface must be very deep due to erosion of material on the highlands. A recommendation is offered for photography, including design of a camera, of the Moon's surface.
M.W.R.

N66-16171* Stanford Univ., Calif.
LEVITATION OF DUST ON THE SURFACE OF THE MOON
Hubert Heffner *In* Minn. Univ. Rept. of Aug. 1965 "TYCHO" Meeting Aug. 1965 18 p refs (See N66-16166 07-30) CFSTI: $7.00/MF $2.00
(TG-6)

Dust particles cannot be raised from the surface of the moon by photoelectric space charges, but submicron dust particles can be suspended if they are raised to a sufficient height by micrometeorite impact. An appreciable proportion of these particles will remain suspended as long as the angle to incidence of solar radiation is not too low. It is shown that particles tend to migrate toward the shadow region due to the horizontal component of radiation pressure. Charged dust particles may be a nuisance as well as a danger to an astronaut, particularly if he falls. During the daylight hours, the astronaut's suit will charge positively due to the photoelectric effect, and thereby repel the suspended particles which are also positively charged. If he should fall, however, he would encounter a layer of particles approximately half of which are negatively charged. Attempts to wipe off these dust coatings will be largely ineffective and will increase electrostatic charge. Experiments under vacuum conditions are recommended to obtain data about electrostatic attraction of dust.
M.W.R.

N66-16172* Stanford Univ., Calif.
THE POTENTIAL AND ELECTRIC FIELD AT THE SURFACE OF THE MOON
Hubert Heffner *In* Minn. Univ. Rept. of Aug. 1965 "Tycho" Meeting Aug. 1965 18 p refs (See N66-16166 07-30) CFSTI: HC $7.00/MF $2.00
(TG-7)

During the lunar day, the surface of the Moon charges to a positive potential due to the photoelectric emission of electrons from its surface. Using the assumptions for solar photon flux below 4000 Å

$$N_p = 2 \times 10^{16} \ \frac{\text{photons}}{\text{cm}^2 \text{ sec}}$$

for quantum efficiency ($\eta = 10^{-3}$) and for the temperature of the photoelectrons

$$\frac{kT_p}{e} = 3 \text{ volts}$$

employed here, we find the potential of the Moon to be approximately 30 volts when the Sun's radiation has normal incidence. The Moon is surrounded by a space charge layer extending outward some eight meters. The electric field at the Moon's surface, under conditions of normal incidence of solar radiation, is approximately 1.8 volts/cm. Somewhat more realistic values for the photoelectron flux ($\eta N_p = 2 \times 10^{11}$), two orders of magnitude less than the value first assumed, yield a surface field of 0.16 volts/cm, a potential of 18 volts, and virtually the same value for the extent of the space charge layer.
Author

N66-16173* Princeton Univ., N. J.
INTERPRETATION OF THE BRIGHTNESS AND POLARIZATION CURVES OF THE MOON
John J. Hopfield *In* Minn. Univ. Rept. of Aug. 1965 "TYCHO" Meeting Aug. 1965 26 p refs (See N66-16166 07-30) CFSTI: HC $7.00/MF $2.00
(TG-8)

Theoretical models are presented for lunar brightness at small phase angles for an underdense surface and the polarization of moonlight. Brightness versus phase angle is discussed; as is the problem of comparing lunar observations, theory, and experiments made on simulated lunar surfaces. Shadow is considered in terms of the lunation cusp and negative polarization.
M.W.R.

N66-16174* Massachusetts Inst. of Tech., Cambridge.
ELECTROMAGNETIC AND THERMAL PROPERTIES OF THE MOON'S SURFACE
Benjamin Lax *In* Minn. Univ. Rept. of Aug. 1965 "TYCHO" Meeting Aug. 1965 19 p refs (See N66-16166 07-30) CFSTI: HC $7.00/MF $2.00
(TG-9)

Radar reflection has provided an estimate of the dielectric constant k of the Moon's surface to depths of meters. The value of $k = 2.6$ corresponds to a porosity of $\approx 70\%$ and a density $\rho \approx 1.0$ gm/cm^3. Thermal measurements at infrared of the lunation and eclipses yield values of the thermal inertia $(K\rho C)^{-1/2} \approx 750$. Since $C = 0.2$ cal/cm sec deg. the thermal conductivity is estimated to be $K \approx 8.5 \times 10^{-6}$ cal/cm sec deg C. From radiometric measurements at microwave and millimeter frequencies the ratio of the thermal and electrical conductivities are determined. This yields an electrical conductivity $\sigma \approx 4.3 \times 10^{-5}$ mho-cm^{-1} corresponding to a loss tangent of $\sigma/\omega \approx 3 \times 10^{-3}$. Bearing strength can be estimated from the density and the thermal inertia when correlated with laboratory measurements of porous and powdered rocks of many varieties. If the estimate is made conservatively to correspond to powdered rock, then the bearing strength is approximately 75 lbs/sq ft.
Author

N66-16175* Minnesota Univ., Minneapolis. Dept. of Physics.
THE EVIDENCE FOR A PARTICULATE MATTER IN SPACE AND ITS POTENTIAL ACCRETION RATE BY THE MOON AND THE EARTH
Edward P. Ney *In its* Rept. of Aug. 1965 "Tycho" Meeting

Aug. 1965 26 p (See N66-16166 07-30) HC $7.00/MF $2.00
(TG-10)

Sources of information about the interplanetary dust are examined. It is shown that the observations on the zodiacal light and the direct observation of particles near the Earth may be made compatible with the Earth collecting dust about 10^4 the volume traced out by the Earth. The infall of dust to the Earth corresponds to an increase in the Earth's radius of about three centimeters per million years. It is estimated that the corresponding figure for the Moon will not exceed about 30 Å per year. To account for lunar erosion, the incoming material would have to stir up more than 100 times its own mass of lunar surface. Author

N66-16176* Minnesota Univ., Minneapolis.
MECHANISMS FOR LUNAR LUMINESCENCE
Edward P. Ney, N. J. Woolf (Princeton Univ.), and Robert J. Collins *In its* Rept. of Aug. 1965 "TYCHO" Meeting Aug. 1965 26 p refs (See N66-16166 07-30) CFSTI: HC $7.00/MF $2.00
(TG-11)

The visibility of luminescence on the Moon depends on the competing processes that illuminate the Moon and that provide energy for luminescence. It is shown that the most favorable times for seeming luminescence are at new Moon on the far side and during rare dark eclipses. The luminosity and color of these rare eclipses is explained. Observations supposedly of luminescence during lunar day are criticized, and only the spectroscopic evidence is taken to support the reality of luminescence. Both direct and storage processes have been considered for converting energy to luminescence. Direct processes in lunar day cannot be energized by presently known sources of particles. If indirect processes occur they may give information about the dust particles at the extreme lunar surface. Author

N66-16177* Princeton Univ., N. J.
STRUCTURE OF THE LUNAR DUST LAYER
Roman Smoluchowski *In* Minn. Univ. Rept. of Aug. 1965 "TYCHO" Meeting Aug. 1965 16 p refs (See N66-16166 07-30) CFSTI: HC $7.00/MF $2.00
(TG-12)

Experiments show that corpuscular radiation such as solar wind can sinter fine dust by producing displaced atoms which diffuse towards the surface of the grain. The estimated rate of churning of the topmost layer of lunar dust excludes sintering through sputtering. It follows that the dust is probably not loose but is partly coherent (0.5 dyne per particle), which increases its mechanical strength and decreases its mobility. Lower layers of dust are compacted by meteoritic bombardment and a close packed density may be reached at a depth of about a meter. Loads which will not sink in loose and in sintered dust are calculated. Author

N66-16178* California Univ., La Jolla.
SOME CONSIDERATIONS CONCERNING RADAR RETURNS FROM THE LUNAR LIMB
Harry Suhl *In* Minn. Univ. Rept. of Aug. 1965 "Tycho" Meeting Aug. 1965 21 p refs (See N66-16166 07-30) CFSTI: HC $7.00/MF $2.00
(TG-13)

Some problems involving the radar backscatter of small objects on a dielectric or conducting plane are treated. These results are used to discuss the wavelength, polarization, and angular (delay) dependence of the radar reflection of the Moon. The sign of the limb polarization is the same in this model as in Hagfors' model. Author

N66-16180*# Harvard Univ., Cambridge, Mass. Meteor Dept.
A THEORETICAL STUDY OF METEORIC TRAJECTORIES AND PROCESSES, INCLUDING EXAMINATION OF THE INCIDENCE AND CHARACTERISTICS OF PHOTOGRAPHIC METEORS BY REDUCTION OF ABOUT 600 DATA POINTS Final Report, 1 Jun. 1963–30 Oct. 1965
F. L. Whipple and R. E. Mc Crosky [1965] 20 p refs
(Grant NsG-460)
(NASA-CR-69875) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Meteor orbital data are tabulated for 363 super-Schmidt double-station photographs which have been measured and reduced by semi-automated procedures. Probably errors of velocities are omitted due to extrapolation limitations, and all measured dashes are included in a least squares solution for the distance along the trail. No photometric measures have been made on any of the meteors. Graphs are included of the distribution of meteor orbits in (1) reciprocal semi-major axis, (2) eccentricity, (3) perihelion distance, and (4) inclination; as well as of the distribution of meteor velocities. M.W.R.

N66-16233*# Yale Univ., New Haven, Conn.
SOME CALCULATIONS PERTAINING TO THE FEASIBILITY OF MEASURING LUNAR HEAT FLOW Final Report
Sydney P. Clark, Jr. Sep. 1965 55 p refs
(Grant NsG-400)
(NASA-CR-69825) CFSTI: HC $3.00/MF $0.50 CSCL 03B

Problems related to the feasibility of measuring lunar heat flow at the lunar surface or in a shallow hole have been investigated. Study of the steady periodic temperatures in the lunar material will give unambiguous information about its properties only if the surface material alone has an appreciable effect on the amplitude and phase of the thermal wave. Layering tends to reduce the amplitude of the fluctuation at a given depth. Large perturbations of heat flow may be caused by irregularities in the surface layer, and closely spaced measurements at a landing site will be required to minimize this error. The blanket method of measuring lunar heat flow is not considered feasible because of the necessity of closely matching the local albedo with the blanket, and because a blanket with properties such that an easily measured gradient free from periodic fluctuations can be set up by the lunar flux requires a prohibitively long time to come to thermal equilibrium. Conversely a blanket with a suitable time constant will yield only a small, seriously disturbed gradient, difficult to measure. Author

N66-16248*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
UNMANNED SYSTEMS TO EVALUATE THE MARTIAN ENVIRONMENT Condensed Summary Report
M. G. Boobar and W. G. Landstrom Sep. 1965 20 p
(Contract NAS2-2477)
(NASA-CR-69997; SID-65-1173) CFSTI: HC $1.00/MF $0.50 CSCL 22A

This report presents a concise description of the study approach, results of manned system environmental sensitivity analyses, and the resulting requirements for unmanned systems designed to acquire the environmental data necessary to support the planning and design of manned Mars missions. Author

N66-16253*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
NUMERICAL RESIDUAL PERTURBATION SOLUTION APPLIED TO AN EARTH SATELLITE INCLUDING LUNI-SOLAR EFFECTS
J. T. Martin and M. C. Eckstein Sep. 1965 191 p refs
(Contract NASw-901)
(NASA-CR-69971; SM-49250) CFSTI: HC $4.00/MF $1.25 CSCL 22A

This report demonstrates the use of an analytic series perturbation solution of the oblateness problem as a reference orbit with numerical solution of the residual perturbation equations of motion including neglected higher order effects as well as perturbations not included in the analytic model. Results obtained from this demonstration program were compared with both single precision and double precision Cowell programs, and showed significant accuracy improvements over the single precision program as well as reducing computing time by a factor of four over the double precision program. Further refinements were suggested in order to obtain the maximum benefit from the technique for a production program. Author

N66-16319# Joint Publications Research Service, Washington, D. C.

ON THE INAPPLICABILITY OF BALDWIN'S CORRELATION TO THE DETERMINATION OF THE CAUSES OF THE FORMATION OF LUNAR CRATERS

G. S. Shteynberg 26 Jan. 1966 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk (Moscow), v. 165, no. 1 p 55–57
(JPRS-33897; TT-66-30340) CFSTI: $1.00

Relationships established by R. B. Baldwin which support the meteorite hypothesis for the formation of lunar craters are discussed. The Baldwin theory states that for craters caused by bombs or by shells, terrestrial meteorite craters, and lunar craters the relationship between the diameter of the crater and, respectively, the depth of the bottom, height of the ridge, and energy of the explosion constitute a single sequence. Baldwin's conclusions were accepted by the advocates of the meteorite hypothesis, in spite of the fact that they indicate only the explosive nature of the formation of craters. In this report the author attempts to show the inapplicability of Baldwin's correlation by explaining that even though lunar craters satisfy the relationships established for explosion craters it does not follow that their origin was derived from meteorites, since for volcanic objects these relationships are also valid. It is concluded that different criteria are needed to refer lunar craters to meteorites or volcanic types. M.R.W.

N66-16322# Joint Publications Research Service, Washington, D. C.

INTERFEROMETERS IN ASTROPHYSICS

V. I. Slysh 2 Feb. 1966 33 p refs Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 87, no. 3, 1965 p 471–489
(JPRS-33968; TT-66-30411) CFSTI: $2.00

Interferometers used to measure angular width of sources in the optical and radio ranges are discussed. Comparisons are made between the Michelson stellar interferometer, the Michelson radiointerferometer, and the intensity interferometer. A discussion on the spatial correlation of radiation is presented and the theory of the metaod for measuring star diameters with interferometers is summarized. M.R.W.

N66-16323# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

THE INHERENT STABILITY OF COUNTERWEIGHT CABLE CONNECTED SPACE STATIONS

D. L. Pitman and B. M. Hall Jul. 1964 20 p refs
(Douglas Paper-3051)

This paper reviews the current theory on the stability of space stations which are rotated to provide an artificial g field. It is shown that despite earlier predictions of instability these configurations are inherently stable because they are operated in conservative force fields. It is also pointed out where previous investigators have erred by assuming constant rotational speed of the system. Finally equations are derived to show that the conservation of angular momentum must be taken into consideration when computing the natural longitudinal frequency of the space station. Author

N66-16379*# Brandeis Univ., Waltham, Mass. Astrophysics Inst.

ON RETARDED EVOLUTION OF PROTOSTARS

J. Anthony Burke (Ph.D. Thesis—Harvard Univ.) Jun. 1965 27 p refs
(Grant NsG-40)
(NASA-CR-69858) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Possible mechanisms for holding protostars in a state of suspended evolution for time scales of the order of 10^{10} years are discussed. Rotation seems to be the only viable conventional mechanism. Magneto-turbulence, a new concept, may provide long term distention forces. Author

N66-16387*# Bendix Corp., Ann Arbor, Mich. Bendix Systems Div.

LUNAR NAVIGATION STUDY, SECTIONS 1 THROUGH 7 Final Report, Jun. 1964–May 1965

L. J. Abbeduto, M. E. Amdursky, D. K. Breseke, J. T. Broadbent, R. A. Gill et al Jun. 1965 299 p refs
(Contract NAS8-11292)
(NASA-CR-69859; BSR-1134, Sec. 1–7) CFSTI: HC $6.00/MF $1.50 CSCL 22C

A lunar navigation analysis was performed to establish parametric performance capabilities of navigation system models to be used for future lunar surface exploration missions and to find technological areas in which research and development efforts will be required. Passive nongyro, and inertial navigation systems, and RF technology were considered as generalized system models for reference point evaluation. Error models were developed in a modular form with emphasis on trade-offs for vehicle design optimization. Proposed lunar exploration plans were reviewed with the goal to obtain complete coverage of the lunar surface by 1985. G.G.

N66-16388*# Bendix Corp., Ann Arbor, Mich. Bendix Systems Div.

LUNAR NAVIGATION STUDY, SUMMARY VOLUME Final Report, Jun. 1964–May 1965

L. J. Abbeduto, M. E. Amdursky, D. K. Breseke, J. T. Broadbent, R. A. Gill et al Jun. 1965 50 p
(Contract NAS8-11292)
(NASA-CR-69860; BSR-1134, Summ. Vol.) CFSTI: HC $2.00/MF $0.50 CSCL 22A

Functional navigation component configurations were evaluated for their suitability in lunar surface and guidance systems. Position fix error models, initial azimuth error models, and dead reckoning error models were formulated and then used to evaluate the effects of parameter variations and to determine navigation errors for typical operating conditions. It was concluded that the principal component error sources for which further research and development are required are distance sensing devices. Also recommended was additional analysis to define and compensate the celestial position fix error induced by deflection of the lunar local vertical. G.G.

N66-16389*# Bendix Corp., Ann Arbor, Mich. Bendix Systems Div.

LUNAR NAVIGATION STUDY, SECTIONS 8 THROUGH 10 AND APPENDICES Final Report, Jun. 1964–May 1965

L. J. Abbeduto, M. E. Amdursky, D. K. Breseke, J. T. Broadbent, R. A. Gill et al Jun. 1965 414 p refs
(Contract NAS8-11292)
(NASA-CR-68285; BSR-1134, Sec. 8–10, Append.) CFSTI: HC $7.00/MF $2.00 CSCL 22C

Summarized are the results on lunar navigation concept studies, their component capabilities, and component requirements. The objective of the analysis was the accumulation of data such that application of the resultant curves will lead to a design point system dependent upon the set of traverse ranges, mission duration, and terminal requirements. The navigation error of each investigated concept is listed in a table. Distance sensing devices, comprised of odometers, accelerometers, and Doppler radar subconcepts evolved as principle component error sources. G.G.

N66-16391*# California Inst. of Tech., Pasadena.
A MODEL OF W VIRGINIS WITH RV TAURI CHARACTERISTICS
Robert F. Christy Jan. 1966 12 p refs
(Grant NsG-426)
(NASA-CR-69820) CFSTI: HC $1.00/MF $0.50 CSCL 22B

Non-linear calculations were used to derive a celestial model representing W Virginis with RV Tauri characteristics at a mass factor near 1.0M⊙. The evolved model had $M=1.75\times10^{22}$gm, $L_0=7.0\pm10^{36}$erg/sec, $R_0=3.2\times10^{12}$ cm, and $Te=5500°$ K. The composition was given by $Y=0.45$ and $Z=0.002$ for a period of 18.5 days and a surface gravity of 11.5. Although this model was unstable at 5500° K, increasing T_e to 6000° K with the same L_0 gave a stable model in the fundamental and in the first harmonic. Also studied were a few nearby models with varied T_e for their instability. G.G.

N66-16396# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON AN APPROXIMATE METHOD OF SOLVING EXTREMUM PROBLEMS
S. N. Kirpichnikov [1965] 8 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), no. 19, 1965 p 143–146

An approximation method utilizing series expansion is applied to the extreme problem of celestial mechanics where the given parameters are substituted by a single parameter e through means of the formula: $\bar{e}_\nu = e_\nu + e'_\nu e + e''_\nu e^2 + \ldots$, $\nu = 1,2,\ldots,k$, so that the chosen problem for $e = 0$ allows the investigation and construction of the solution. A small parameter method was used to find a solution for the case when e is a small quantity by expanding the minimizing function in a power series. Example calculations for a coplanar problem of constructing the optimum single-pulse flight orbit between limiting orbits of a small eccentricity in a central force are given. G.G.

N66-16404# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON A POSSIBLY EXACT TRANSFER IN A CENTRAL FORCE FIELD
V. S. Novoselov [1965] 13 p refs Transl. into ENGLISH from Uch. Zap. Leningr. Univ. (Lenigrad), no. 328, 1965 p 150–159

Considered is the model transfer problem of a point along the ellipse between two coplanar circular orbits in a Newtonian attractive force field. The transfer is accomplished by an instantaneous change in velocity on the initial and final orbits through variational analysis and the Bolza problem for minimizing the functional boundary conditions, the equations of motion for a point in a central field, and the constraints on the control functions is formed. Calculations show that the variance of the residuals in the radial and transversal velocities is less than the variance in the final radial velocity for the Homann ellipse. Energy expenditures to the first order equal the expenditures in accomplishing the transfer by means of Homann ellipse. G.G.

N66-16426*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
SPACE RESEARCH: DIRECTIONS FOR THE FUTURE, PART 3
Feb. 1966 328 p refs
(Contract NSR-09-012-903)
(NASA-CR-70003) CFSTI: HC $6.00/MF $1.75 CSCL 22A

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4. CAPABILITIES AND REQUIREMENTS FOR MANNED PLANETARY MISSIONS F. P. Dixon p 179–190 (See N66-16427 07-30)
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N66-16427* National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
CAPABILITIES AND REQUIREMENTS FOR MANNED PLANETARY MISSIONS
Franklin P. Dixon *In its* Space Res.: Direc. for the Future, Pt. 3 Feb. 1966 p 179–190 (See N66-16426 07-30) CFSTI: HC $6.00/MF $1.75

Possible manned planetary missions are summarized and some of the problems related to man's presence are discussed. With the exception of biomedical problems and questions of man's performance in extended space missions, there appear to be engineering solutions that lend confidence that a manned planetary-landing program can be developed. E.E.B.

N66-16458*# California Inst. of Tech., Pasadena.
ON THE OPTIMUM CHOICE OF CENTRAL VARIABLES IN PROBLEMS OF STELLAR STRUCTURE
John Faulkner [1964] 15 p refs
(Contracts NGR-05-002-028; Nonr-220(47))
(NASA-CR-69865) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Mathematical difficulties in calculations of the central regions of a stellar model are shown to be due to a wrong choice of variables. New variables are derived which permit outward integration to commence at the center of a model. They appear to lead to the highest attainable central accuracy for a given integration process in a digital computer.
Author

N66-16463*# National Biomedical Research Foundation, Silver Spring, Md.
INVESTIGATION OF THERMODYNAMIC MECHANISMS FOR THE PRODUCTION OF COMPOUNDS ESSENTIAL FOR THE ORIGIN OF LIFE First Quarter Technical Report, Oct. 1–Dec. 31, 1965
Margaret O. Dayhoff, Richard V. Eck, and Ellis R. Lippincott [1965] 38 p refs
(Contract NSR-21-003-002)
(NASA-CR-69965) CFSTI: HC $2.00/MF $0.50 CSCL 03B

From present information on the composition, pressures, and temperatures of planetary atmospheres, we have calculated the expected thermodynamic equilibrium composition of the atmospheres of the Earth, Venus, Mars, and Jupiter. Departures from thermodynamic equilibrium must

be attributed to special mechanisms, including, on the Earth, biological activity. The major constituents of the terrestrial atmosphere are found to be in approximate thermodynamic equilibrium; while many minor constituents have abundances exceeding their equilibrium values, there is a marked tendency for equilibrium to be restored. It appears that the atmosphere of Venus is in thermodynamic equilibrium, while that of Jupiter is not. The evidence for Mars is less conclusive, although not inconsistent with thermodynamic equilibrium. For none of these planets is there a molecular species with a large predicted equilibrium abundance and spectroscopically accessible absorption features which has not been already identified. The predicted equilibrium abundances of oxides of nitrogen are extremely low on all planets. Author

N66-16478# National Academy of Sciences—National Research Council, Washington, D. C.
GROUND-BASED ASTRONOMY, A TEN-YEAR PROGRAM
25 Aug. 1964 139 p

This report presents a balanced program for new facilities of ground-based astronomy in the next decade, well justified by the important scientific opportunities which are briefly discussed. The report was prepared by the panel on Astronomical Facilities for the Committee on Science and Public Policy of the National Academy of Sciencies. It recommends certain new facilities, to be acquired at a rate based on an internal criterion; a conservative estimate of the rate at which astronomical progress can be made. Construction programs are described for both radio and optical telescope facilities. Cost estimates of the proposed facilities are discussed in detail. M.R.W.

N66-16491# Tokyo Astronomical Observatory (Japan).
SPECTRAL CLASSIFICATION AND THREE-COLOR PHOTOMETRY OF A-TYPE PECULIAR STARS
Kiyoteru Osawa 1965 28 p refs *Its* Ann. of the Tokyo Astron. Obs., Ser. 2, v. 9, no. 3
CFSTI: HC $2.00/MF $0.50

Spectral classification by a homogeneous system (dispersion 60A/mm) and three-color photometry of 244 A-type peculiar stars were made with 188-cm and 91-cm reflectors. This programme includes many of the stars of this kind listed in Bertaud's Catalogue. For each spectrum three or four spectral types judged by He I, by Balmer lines, by the K-line and by metallic lines were given separately. These equivalent types are discordant with each other. On the average, the hydrogen spectral types are the nearest to the colors. For B-type peculiar stars, the color $(U-B)_o$ is in general bluer than the helium spectral type. For A-type peculiar stars, K-line type is earlier and metal-line type is later than B-V. Ultraviolet excess may be present for some of the A-type peculiar stars. This tendency becomes more pronounced if color indices are corrected for line blanketing. This fact can be interpreted by a composite nature of the atmospheric structure of peculiar stars. Author

N66-16500# United Nations. General Assembly. Committee on the Peaceful Uses of Outer Space.
SPACE ACTIVITIES AND RESOURCES Review of United Nations, International and National Programmes
1965 190 p refs Supersedes A/AC.105/L.12; A/AC.105/L.13 (A/AC.105/26; A/AC.105/L.12; A/AC.105/L.13) Available from U.N., New York: $2.00

The activities and resources of the United Nations are reviewed, including the work of specialized agencies and other international bodies such as intergovernmental, regional, and nongovernmental organizations. The programs, functions, and structures are summarized for each group involved in the expanding pattern of cooperative effort in the peaceful uses of outer space. National and cooperative international space activities are also reviewed, with information provided on the scope and type of outer space research being carried out by member states. M.G.J.

N66-16501# Royal Astronomical Society, London (England).
A SURVEY OF RADIO SOURCES BETWEEN DECLINATIONS 20° AND 40°
J. D. H. Pilkington and P. F. Scott 1965 48 p refs *Its* Mem. of the Roy. Astron. Soc., v. 69, pt. 5
CFSTI: HC $2.00/MF $0.50

The results of a survey of radio sources between +20° and +40° using a large interferometer at 178 Mc/s are presented. The methods of observation and reduction are described, and the possible sources of error discussed. The catalog lists the positions and flux densities of 1210 sources having $S \geq \times 10^{-26}$ $w.m^{-2}$ $(c/s)^{-1}$ at 178 Mc/s. Author

N66-16549*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THEORETICAL RELATIONSHIPS FOR METEOROID PUNCTURE EXPERIMENTS
Charles C. Dalton Washington, NASA, Feb. 1966 31 p refs (NASA-TN-D-3244) CFSTI: HC $2.00/MF $0.50 CSCL 03B

In unshielded meteoroid measurement satellite experiments where vehicle attitude information is available without information about the meteoroid closing velocity vector, the probable radiant and the puncture flux enhancement factor for sporadic meteors should be based on the assumption that velocity vectors for ambient meteoroids are isotropically distributed. Then, although half of the meteoroids which impact onto a flat transducer are more than 45 degrees from the normal, those within 45 degrees puncture three times more effectively than the others, and half of the puncturing meteoroids are less than 33.5 degrees from the normal when the earth is below the surface horizon. This distribution also implies that the flux of puncturing meteoroids is five times greater than the flux of incident meteoroids with mass equal to or greater than the mass of the almost-puncturing meteoroid with the average values of density, velocity, and impact angle. The formulas for the celestial coordinates of the probable radiant of a puncturing meteoroid have been corrected for earth-shielding. Author

N66-16565*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN ANALYTICAL INVESTIGATION OF A SIMPLIFIED THRUST-VECTOR ORIENTATION TECHNIQUE FOR ESTABLISHING LUNAR ORBITS
L. Keith Barker and Gene W. Sparrow Washington, NASA, Feb. 1966 24 p refs
(NASA-TN-D-3296) CFSTI: HC $1.00/MF $0.50 CSCL 22C

The motion of the spacecraft during lunar orbit establishment was assumed to be planar. The technique consists in maintaining a constant angle between the thrust axis of the spacecraft and the line of sight to the lunar horizon during the braking maneuver while the orbit is being established. It was found that near-circular parking orbits which are closely confined to the pericynthion altitude of the approach trajectory (80 international nautical miles or 148 160 m) can be established very efficiently by the use of the simplified guidance technique. The simplicity introduced by this technique appears to make it useful for manual control. Author

N66-16591*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DESIGN PARAMETERS FOR BALLISTIC INTERPLANETARY TRAJECTORIES. PART II: ONE-WAY TRANSFERS TO MERCURY AND JUPITER

V. C. Clarke, Jr., W. E. Bollman, P. H. Feitis, and R. Y. Roth 15 Jan. 1966 328 p refs
(Contract NAS7-100)
(NASA-CR-70154; JPL-TR-32-77) CFSTI: HC $7.00/MF $1.75 CSCL 22C

The general characteristics of ballistic interplanetary trajectories are discussed, and detailed equations are developed for the analytical model. Extensive data are presented in graphical form for trajectories to Mercury (launch dates: 1967–1968) and Jupiter (launch dates: 1968–1973). These graphs include: (1) curves of *vis viva* geocentric energy vs launch date for minimum-energy trajectories and (2) curves of 19–21 different trajectory parameters vs launch date for various *vis viva* geocentric energies. The trajectories were computed on the IBM 7090 digital computer by numerical evaluation of the analytical model, after which specific parameters of interest were automatically plotted, carefully checked, and analyzed. Procedures are outlined for use of these data by the trajectory engineer in the design and analysis of interplanetary trajectories. Author

N66-16592*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE TRAJECTORIES PROGRAM FOR THE IBM 7090 COMPUTER
D. B. Holdridge 1 Sep. 1962 97 p refs Revision No. 1
(Contract NAS7-100)
(NASA-CR-70153; JPL-TR-32-223, Rev. 1) CFSTI: HC $3.00/MF $0.75 CSCL 22C

The Space Trajectories Program for the IBM 7090 computer is described in comprehensive detail, with emphasis on the development of the equations. Equations of motion for both the Cowell and Encke methods are given. Numerical experience with the class of trajectories encountered in practice is included to compare the Cowell and Encke methods, and to obtain an estimate of the over-all accuracy of the program. Sources of error are pointed out, consistent with the precision of the numerical methods. Operating instructions and descriptions of input and output are provided for the successful running of trajectories. Flow charts presented serve as a guide to the understanding of the internal sequence of events and control methods. Major subroutines used in the program are contained in the Appendix. The program is written in the Fortran Assembly Program language. Author

N66-16597*# Michigan Univ., Ann Arbor.
INVESTIGATION OF GALACTIC AND PLANETARY RADIO ASTRONOMY Third Semiannual Status Report, Jan.-Jun. 1966
Fred T. Haddock Jan. 1966 14 p
(Grant NsG-572)
(NASA-CR-70152) CFSTI: HC $1.00/MF $0.50 CSCL 22A

Progress is reported on studies in galactic and planetary radio astronomy. During this period efforts on the galactic radio astronomy task were almost entirely devoted to the final preparation of the 11.03 rocket payload, culminating with its successful launching. Mechanical problems, the completion of payload and testing, and calibration of the radiometers are discussed. Work performed on the kilometer wave orbiting telescope studies is also presented. Efforts on the planetary radio astronomy task were directed towards photochemical studies of the C-O complex, Martian ionospheric studies, and investigations of topside electron density profiles and forces on nonrigid bodies in space. R.N.A.

N66-16601*# Melpar, Inc., Falls Church, Va. Space Systems Lab.
ANALYSIS OF THE F-CORONA ACCORDING TO THE MIE THEORY. PART I: MATHEMATICAL FORMULATION AND UNIQUENESS OF THE DERIVED THEORETICAL MODELS
R. S. Powell and R. R. Circle 18 Dec. 1965 49 p refs
(Contract NASw-1206)
(NASA-CR-70148) CFSTI: HC $2.00/MF $0.50 CSCL 03B

A mathematical model is formulated to remove the integrals over scattering angle and particle size which occur in analyzing observations of the zodiacal light. The resulting algebraic equations are expressed in terms of scattering functions with known and easily recognizable properties. Consequently, the uniqueness of deductions concerning the nature of the interplanetary dust can be determined by studying the mathematical behavior of these functions. In addition, the simplified mathematical formulation allows one to judge the relative value of various observations. Single color observations at elongations in the range $20° < \epsilon < 70°$ give unique information concerning the size distribution of the interplanetary dust but not the chemical composition or electron density. Multi-color observations in this range help in determining the electron density but not the chemical composition. Multi-color observations in the range $110° < \epsilon < 180°$ are most valuable in determining the electron density and chemical composition. It is shown that the radial decay constant, α, must be less than 1.5. Author

N66-16633# Martin Co., Baltimore, Md.
ORBIT DETERMINATION AND ANALYSIS BY THE MINIMUM VARIANCE METHOD Scientific Report No. 1, Jun. 1964–May 1965
Karlis Minka Aug. 1965 89 p refs
(Contract AF 19(628)-4167)
(ER-13950; AFCRL-65-579; AD-625453) CFSTI: HC $3.00/MF $0.75

The aspects of accurate determination of earth satellite orbits by the minimum variance method are presented. In addition, techniques for the determination of the associated physical constants, such as the coefficients in the earth's gravitational potential, exospheric temperature, etc., are developed. A method for determination of the state transition matrix is presented. Also included are a review of the time systems employed in satellite orbit determination and a short discussion of the types of observations. The mathematical model of the dynamical system includes nine zonal harmonics and up the fourth order tesseral harmonics of the earth's gravitational potential. Atmospheric drag effects are included on the assumption that the atmosphere rotates with the angular velocity of the earth. First order solar and lunar gravitational attractions and solar radiation pressure are also treated. The satellite orbits are integrated in a reference system which considers the precession and nutation of the earth. Rectangular coordinate systems are used throughout the development. Author (TAB)

N66-16667# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STATISTICAL EVIDENCE OF THE MASSES AND EVOLUTION OF GALAXIES
Thornton L. Page 10 Dec. 1965 44 p refs
(SAO Special Rept.-195)

Measured velocities in pairs, groups, and clusters of galaxies have been used to estimate average masses. In pairs, these estimates depend strongly on the morphological type of the galaxies involved. In clusters, the measured motions imply much larger average masses, or the existence of intergalactic matter, or instability, and present a serious difficulty in identifying the members of clusters. Other measurable characteristics

of galaxies in pairs; their orientations, dimensions, types, and luminosities; are also correlated, suggesting a common origin; but the effects of selection, as pointed out by Neyman, are shown to affect the results. These studies are all related to the problem of evolution of galaxies summarized in a brief resumé.
Author

N66-16757# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET LAUNCH-VEHICLE TESTS IN THE PACIFIC OCEAN
Surveys of Soviet Scientific and Technical Literature
W. Hrubiak 30 Dec. 1965 45 p refs
(ATD-65-83)

Soviet launch vehicle tests carried out in the Pacific Ocean from January, 1960, through January, 1965, are reported. The first section contains a summary of the tests in tabular form, together with a Mercator projection showing the test areas. Next, an analysis divides the tests into three basic groups. The first group includes tests conducted between 20 January and 8 July, 1960, to determine reliability and accuracy of guidance systems, measuring instruments, and communications equipment. The second group was conducted in 1961 and 1962 during which time a new type of rocket was introduced. The last group starts with Test Series VI, announced on 29 November, 1963. It is conjectured that with this series the Soviet started testing some recoverable and reusable versions of vehicles which will be used to launch heavy spacecraft into earth orbit, well as sections of space stations to be assembled in orbit. The final section is given to translations of TASS news releases.
D.T.

N66-16799*# Massachusetts Inst. of Tech., Cambridge.
CORRELATION OF INTERPLANETARY GEOMETRY WITH PROPULSION REQUIREMENTS FOR OPTIMAL LOW THRUST MISSIONS
Neal A. Carlson (M.S. Thesis) Feb. 1965 165 p refs
(Contract NsG-254-62)
(NASA-CR-62005; TE-12) CFSTI: HC $5.00/MF $1.00 CSCL 22C

A simple technique for preliminary mission planning based on the time-dependent orbital geometry of the launch and target planets is developed. Numerical data is presented showing the variation with launch date and flight time of propellant requirements for ballistic and low-thrust heliocentric trajectories. The propellant requirements of each trajectory are then reduced to a characteristic length essentially independent of the propulsion mode by application of relations derived for transfers in field-free space. The characteristic length is further shown to be a unique parameter of each trajectory which is roughly equal to the planetary separation distance near the mid-point of the transfer. An averaged trajectory is thus defined for each actual interplanetary trajectory: that transfer in field-free space between the positions of launch and target planets at a mean trajectory time near the mid-point to the flight.
Author

N66-16818# Joint Publications Research Service, Washington, D. C.
THE SHANGHAI OBSERVATORY
Li Heng and Hui-Ch'eng Tsou *In its* Transl. on Communist China's Sci. and Technol., No. 275 10 Jan. 1966 p 1-7 Transl. into ENGLISH from T'ien-Wen Ai-Hao-Che (Peking), no. 10, 1965 p 1-3 (See N66-16817 07-34) CFSTI: $2.00

A brief historical survey of the Shanghai Observatory and its affiliated substations is given. This observatory uses a large reflector telescope to observe the absolute orbits of stars with extragalactic nebulae as the background. Other activities include fixations of calendar time and geocentric positions, orbital changes of small planets, surveying of comet orbits, time and frequency relationships, etc.
G.G.

N66-16932# Royal Aircraft Establishment, Farnborough (England).
THE EFFECT OF TRANSFER INJECTION ERRORS UPON THE ACCURACY OF HIGH CIRCULAR ORBITS
Keith Smith Jul. 1965 74 p refs
(RAE-TR-65153)

First-order relationships between the position and velocity errors at start and end of a Hohmann transfer are derived in a two-dimensional analysis. The results are then used to evaluate the effects of uncorrected first injection errors upon the mean radius and eccentricity of the final (nominally circular) orbit, assuming perfect application of the final impulsive velocity. Finally the mean radius and eccentricity errors are expressed in terms of post-orbital velocities required for nulling, such as would be required in station-keeping communication satellite systems.
Author

N66-16948# Lockheed Missiles and Space Co., Palo. Alto, Calif. Research Lab.
A MODEL FOR THE LOWER ATMOSPHERE OF MARS BASED ON MARINER IV OCCULTATION DATA
Albert D. Anderson Dec. 1965 34 p refs
(LMSC-6-75-65-62)

The Mariner IV occultation experiment has resulted in low values for the neutral properties (temperature, pressure, and density) and the dominance of CO_2 for the lower atmosphere of Mars. Guided by these new results and theoretical models of the Martian atmosphere, a neutral property model has been derived which takes into account surface air temperature variation. The neutral properties up to 50 km exhibit strong dependence on the surface temperature. An isopycnic (constant density) level is manifested in the model at 10 km where the density value is 5.77×10^{-6} gm cm^{-3} for surface temperatures ranging from 175 to 325° K. At 50 km, the density variation for this same surface temperature range is a factor of four. The height of the tropopause (boundary between convective and radiative equilibrium regimes), taken to vary linearly with the surface temperature, is one of the principal uncertainties since the computed properties are sensitive to it. The accuracy of the model appears to decrease with altitude, especially above 30 km where the effects of CO_2 photochemistry, doppler broadening, and departure from local thermodynamic equilibrium start to become important.
Author

N66-16962# Royal Aircraft Establishment, Farnborough (England).
PERTURBATIONS OF SATELLITE ORBITS BY THE GRAVITATIONAL ATTRACTION OF A THIRD BODY
Myrna M. Lewis Jun. 1965 25 p refs
(RAE-TR-65118) CFSTI: HC $1.00/MF $0.50

Equations giving the rates of change of the six orbital elements of a close satellite due to the gravitational attraction of a third body are derived using Lagrange's planetary equations. Modified expressions are also given for evaluating the perturbations when only first order terms in the eccentricity of the disturbing body are retained.
Author

N66-16981*# Arizona State Univ., Tempe. Coll. of Engineering Sciences.
ATTITUDE STABILITY OF A SPINNING PASSIVE SATELLITE IN A CIRCULAR ORBIT Semiannual Technical Progress Report, Jun. 1-Nov. 30, 1965

Leonard Meirovitch [1965] 54 p refs
(Grant NGR-03-001-014)
(NASA-CR-70262) CFSTI: HC $3.00/MF $0.50 CSCL 22A

The mathematical model consists of a rigid body with two flexible antennas. A simplified model uses two viscously damped oscillators to simulate the antennas. For a body moving in a circular orbit it is convenient to introduce a frame of reference orbiting with the body. This investigation is concerned with the possibility that the motion in which the body undergoes no rotation with respect to the orbiting frame of reference is stable. To this end the direct method of Liapounov is used for the case in which the center of the rigid body is constrained to move in a circular orbit as well as for the unconstrained case. The conclusion is that the orbital constraints assumption just defined is not valid. It is approximately valid if the mass of the oscillators is small relative to the mass of the rigid body. Stability criteria have been derived for three equilibrium configurations which are intimately related to the gravity-gradient stabilization case for the rigid body.
Author

N66-17009# Naval Research Lab., Washington, D. C.
DIRECTIONAL EQUILIBRIUM OF AN ARTIFICAL SATELLITE ENVELOPING A NONUNIFORM REGION OF A GRAVITATIONAL FIELD
P. A. Crafton 25 Oct. 1965 14 p ref
(NRL-6321; AD-624592) CFSTI: HC $1.00/MF $0.50

Certain artificial satellites used for communications and/or navigation require means of directional stabilization. If the satellite encompasses an essentially uniform region of the gravitational field, it is in neutral directional equilibrium in that force field. The creation of an artificial satellite with a discrete distribution of mass permits us to have a satellite encompassing a nonuniform region of the gravitational field although having a relatively low total mass. The basic mathematical relationships are developed that must be satisfied by any gravity-gradient satellite in order that it have stable directional equilibrium. The satellite is assumed to have a discrete distribution of mass, and is assumed to be not subjected to other body forces, radiation forces, and disturbing forces.
Author (TAB)

N66-17044*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPUTATION OF GENERAL PLANETARY PERTURBATIONS. PART III: AN EXPANSION OF THE DISTURBING FORCE
Lloyd Carpenter Washington, NASA, Feb. 1966 23 p refs
(NASA-TN-D-3078) CFSTI: HC $1.00/MF $0.50 CSCL 03C

An expansion of the planetary disturbing force is given in a form convenient for a method of successive approximations in the application of the method of rectangular coordinates. The difficulties associated with slow convergence along powers of the planetary masses are absorbed in the iteration process.
Author

N66-17046*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM. VOLUME A: FRAMEWORK FOR SYNTHESIS
21 Feb. 1966 36 p ref
(Contract NASw-1215)
(NASA-CR-70358) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A framework is presented for synthesizing a meaningful experiment program for Orbiting Research Laboratories (ORLs). The results of this study lay the groundwork for the effort required to implement the experiment program. Consideration is given to the nature and scope of the program, user oriented procedures for synthesizing the program, and scientific and technical areas. These areas incorporate earth oriented applications, support for space operations, and space sciences.
C.T.C.

N66-17056*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM, VOLUME B, PART X: EXTRAVEHICULAR ENGINEERING ACTIVITIES
21 Feb. 1966 178 p refs
(Contract NASw-1215)
(NASA-CR-70344) CFSTI: HC $4.00/MF $1.00 CSCL 22A

Relative to synthesizing an experiment program for Orbital Research Laboratories (ORLs), an illustration is given of the application of the synthesis approach to the extravehicular engineering activities scientific and technical area. The objective of these activities is the development of equipment, techniques, and procedures to enable astronauts, either directly or by remote control, to perform those extravehicular tasks needed for conduct of advanced space operations and for support of experiments in the other S/T areas. Consideration is given to the identification of selected knowledge requirements and the derivation of experiment requirements. These include prospective orbital activities, and equipment functional and supporting research requirements. Illustrations and identifications of selected knowledge requirements, discussions of relativity experiments using an artificial earth satellite, and evaluations of indicative phenomena and functional requirements are appended.
C.T.C.

N66-17057*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM, VOLUME B, PART XI: ASTRONOMY/ASTROPHYSICS
21 Feb. 1966 125 p
(Contract NASw-1215)
(NASA-CR-70345) CFSTI: HC $4.00/MF $1.00 CSCL 03B

Relative to synthesizing an experiment program for Orbital Research Laboratories (ORLs), results of studies are given which illustrate the application of the synthesis approach to the astronomy/astrophysics area. The objectives of this area are to determine the constitution, physical characteristics, and dynamics of celestial bodies; the nature of processes which occur in the extreme physical conditions existing in stellar objects; the history and evolution of the universe; and whether the laws of nature are universal in the space-time continuum. Consideration is given to the identification of selected knowledge requirements and the derivation of experiment requirements. These include equipment functional and supporting research requirements, and prospective orbital activities. Appendices include illustrations and identifications of selected knowledge requirements, discussions of relativity experiments using an artificial earth satellite, and evaluations of indicative phenomena and functional requirements.
C.T.C.

N66-17060*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM. VOLUME C: GUIDELINES FOR COMPREHENSIVE FLIGHT PROGRAM
21 Feb. 1966 45 p
(Contract NASw-1215)
(NASA-CR-70354) CFSTI: HC $2.00/MF $0.50 CSCL 22C

Relative to synthesizing an experiment program for the Orbiting Research Laboratories (ORLs), an interrelation is given of thirteen previously derived scientific/technical experiment areas. A rationale is set forth for grouping prospective experiments into payloads and missions compatible with prescribed constraints. As an example of the approach, this presentation employs the grouping rationale to arrive

at guidelines for mission and flight assignments for the initial phase of the manned earth orbital experiment program, using Apollo applications program systems. C.T.C.

N66-17062*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM, VOLUME C. ANNEX 2: GUIDELINES FOR COMPREHENSIVE FLIGHT PROGRAM
21 Feb. 1966 210 p refs
(Contract NASw-1215)
(NASA-CR-70353) CFSTI: HC $5.00/MF $1.25 CSCL 22A

A compilation of representative experiments to be conducted with the Orbital Research Laboratory (ORL) is presented. These experiments are to be made in the following general areas: biomedicine/behavior; advanced technology and supporting research; operations techniques and advanced mission spacecraft subsystems; extravehicular engineering activities; astronomy/astrophysics; bioscience; and physical sciences. Included with each proposed experiment are a discussion of the objectives, expected results, the relation to other experiments, a description of the experiment, mission and orbital characteristics, and astronaut involvement. C.T.C.

N66-17063*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM. VOLUME D: SUMMARY OF RESULTS
21 Feb. 1966 42 p refs
(Contract NASw-1215)
(NASA-CR-70352) CFSTI: HC $2.00/MF $0.50 CSCL 22A

A framework is presented for synthesizing a meaningful earth orbital experiment program for Orbital Research Laboratories (ORLs). A summary of results reached in this study is given and includes: an identification of scientific/technical area knowledge requirements to be addressed by the ORL experiment program; derivation of experiment requirements of the individual S/T areas; and an interlacing of experiment requirements of individual S/T areas into an overall ORL program plan. C.T.C.

N66-17085*# Wisconsin Univ., Madison.
STELLAR SPECTROPHOTOMETRY IN THE FAR ULTRAVIOLET Final Report
Arthur D. Code [1964] 15 p refs
(Contract NASw-66)
(NASA-CR-70302) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Brief summaries are given of study areas relative to stellar spectrophotometry in the vacuum ultraviolet (UV). It is reported that work was conducted toward the design of a small 300 pound satellite, and this provided the basis for the design of a larger experimental package for the Orbiting Astronomical Observatory. In the course of this work, laboratory instrumentation was developed for testing and calibrating vacuum UV optical equipment and for fabricating UV interference filters and mirror coatings. Other study areas reported are the design and construction of a stable platform for use in the X-15 rocket plane in order to conduct ultraviolet measurements and various theoretical investigations. C.T.C.

N66-17089*# Stanford Univ., Calif. Radioscience Lab.
RADAR STUDIES OF THE CISLUNAR MEDIUM Scientific Report No. 12, Dec. 1963–Apr. 1964
Philip Yoh Dec. 1965 108 p refs
(Grant NsG-377)
(NASA-CR-70322; SEL-65-091) CFSTI: HC $4.00/MF $0.75 CSCL 03B

The aim of this research was to determine properties of the cislunar medium by means of lunar radar investigations. Simultaneous Doppler-frequency and Faraday-polarization measurements were made on harmonic radio frequencies near 25 and 50 Mc over a period of about five months during sunspot minimum, from December 1963 to April 1964. The experimental results have led to discovery of both temporal and spatial variations of the electron content in the cislunar medium above the earth's ionosphere. The temporal variation of the electron content is attributed to the close coupling by means of exchange of ionization between the ionosphere and the lower magnetosphere. A net upward electron flux of about 3.7×10^{12} m^{-2} sec^{-1} is found in the morning; the corresponding number for the downward flow in the afternoon is 2.6×10^{12} m^{-2} sec^{-1}. The spatial variation is believed to correspond to the plasma wake of the earth in the solar wind. Author

N66-17090*# IIT Research Inst., Chicago, Ill. Astro Sciences Center.
THE SCIENTIFIC OBJECTIVES OF DEEP SPACE INVESTIGATIONS: SATURN, URANUS, NEPTUNE AND PLUTO
P. J. Dickerman Jan. 1966 54 p refs
(Contract NASr-65(06))
(NASA-CR-70328; P-11) CFSTI: HC $3.00/MF $0.50 CSCL 03B

A study was made of scientific objectives for the four outermost planets: Saturn, Uranus, Neptune, and Pluto. Differences between these planets and planets nearer the sun are shown in a general survey of their structure and composition, and in detailed discussions of the individual bodies. Descriptions of the atmospheres are given, primarily with the aid of spectroscopic and radiometric observations, and better known characteristics are tabulated. Reasons for making probes to these planets are given, and proposed measurements are discussed. These include magnetic field determinations throughout the mission and in the region of the planets; spectrometry and polarimetry of the planetry atmospheres; microwave radiometry and radar probing; charged particle detection in trapped radiation belts; optical occultation experiments for Saturn's ring system and atmospheric studies; rf occultation experiments for atmospheric density determinations; and photography of cloud structure and surface features. C.T.C.

N66-17109*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-34, VOLUME VI FOR THE PERIOD MAY 1, 1965 TO JUNE 30, 1965. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
31 Jul. 1965 57 p refs
(Contract NAS7-100)
(NASA-CR-70335; JPL-SPS-37-34, Vol. VI) CFSTI: HC $3.00/MF $0.50 CSCL 22A

Activities, research, and development efforts for lunar and planetary-interplanetary programs; for a deep space instrumentation facility; and for general space science instrumentation are reported and discussed. A trajectory analysis for the Ranger VIII is presented; and Surveyor systems were tested. In the Mariner IV project, flight operations and radio subsystem performance is discussed. Tracking stations engineering and operations; and testing activities are outlined for the deep space instrumentation facility. Failure analyses were conducted on the Mariner IV ionization chamber, and plasma probe. The spacecraft's television system is interpreted, and spurious television image phenomena are discussed. L.S.

N66-17226*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE EQUILIBRIUM ELECTRIC POTENTIAL OF A BODY IN THE UPPER ATMOSPHERE AND IN INTERPLANETARY SPACE

Elden Cole Whipple, Jr. (Ph.D. Thesis—George Washington Univ.) 6 Jun 1965 160 p refs

(NASA-TM-X-55368; X-615-65-296) CFSTI: HC $5.00/MF $1.00 CSCL 22A

Poisson's equation has been solved numerically for high-velocity spheres, and the ion current obtained by an analysis of the ion's distance of closest approach. Measurements of photoelectric yields are reviewed and compared with photocurrents measured above the atmosphere. A magnetic field induces a potential gradient in a moving body; in addition, the restriction of electrons to a spiralling motion along the field line decreases the body's effective collection area. These charging mechanisms are evaluated for conditions in the upper atmosphere and in interplanetary space, and are combined into expressions from which the equilibrium potential may be determined. Positive values are limited to a few volts, but large negative values are possible. In interplanetary space positive potentials due to both photomission and the solar wind protons are expected. The equilibrium potential of the satellite Explorer VIII has been measured in both darkness and sunlight. There is general agreement with theoretical values at higher altitudes. At low altitudes the measured potentials are more negative than anticipated. Author

N66-17228*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LINEAR ESTIMATION AND RELATED TOPICS

Raymond V. Borchers Sep. 1965 46 p refs

(NASA-TM-X-55371; X-547-65-367) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A collection of theorems, definitions, and other facts about the multivariate Gaussian distributions are presented to give desirable properties of linear estimators and to examine some statistical techniques of linear estimation used in the differential correction of orbits of near earth satellites. Basic concepts of classical orbit correction are included to show where the need arises for estimating such quantities as orbital parameters, geodetic parameters, etc. Different estimation techniques are discussed, including unweighted least squares, conventional weighted least squares, maximum likelihood, Bayes, and Kalman-Schmidt filter. All these techniques except Kalman-Schmidt use all the observations simultaneously in arriving at an estimate for the orbital parameters. The Kalman-Schmidt filter permits a complete optimum estimate of the orbital parameters from each single observation and hence operates sequentially on the observations one at a time in the order of their occurrence. R.N.A.

N66-17231*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RADIATIVE EQUILIBRIUM IN PLANETARY ATMOSPHERES. II: AN ANALYSIS AND INTERPRETATION OF SOME VENUS OBSERVATIONS BASED ON A SINGLE REFLECTING CLOUD LAYER MODEL

F. Bartko and R. A. Hanel Sep. 1965 68 p refs

(NASA-TM-X-55392; X-622-65-436) CFSTI: HC $3.00/MF $0.75 CSCL 03B

The equilibrium temperature distribution, thermal emission spectrum, and limb function of a nongrey N_2-CO_2-H_2O model atmosphere have been computed for a large variety of atmospheric parameters which are appropriate for the atmosphere of Venus in the vicinity of the cloud tops. Near infrared absorption by CO_2 of direct and diffusely reflected solar radiation have been included. The important effects of the near infrared solar heating by CO_2 absorption, the water vapor amount, and the cloud top pressure level on the computed results are demonstrated. Other conclusions resulting from a study of the water vapor abundance and thermal emission spectrum depend on the cloud composition. These results are based on the assumption of a single reflecting cloud layer, an assumed CO_2 concentration of 5% and a brightness temperature of 225°K for the cloud tops in the 8–13μ spectral interval. Author

N66-17237*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A SOLUTION FOR SATELLITE ORBIT TIME IN UMBRA AND PENUMBRA WITH APPLICATION TO A LUNAR SATELLITE MISSION ANALYSIS

J. D. Kraft Nov. 1965 40 p refs

(NASA-TM-X-55400; DR-105; X-470-65-472) CFSTI: HC $2.00/MF $0.50 CSCL 22C

Equations comprising a solution for the time spent by a satellite in umbra and penumbra are derived. Umbra and penumbra regions are assumed to be right circular cones, and shadowing bodies are assumed spherical. Pertinent constants are evaluated for shadowing by both the earth and the moon. The solution is applied in predicting shadow time distributions for lunar satellite orbit. Author

N66-17246*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A BIBLIOGRAPHY OF MULTIPLE NIGHTLY OBSERVATIONS OF COMET TAILS

Stephen Plagemann (Maryland Univ.) Sep. 1965 18 p refs (Grant NsG-695)

(NASA-TM-X-55370; X-612-65-362) CFSTI: HC $1.00/MF $0.50 CSCL 03B

A bibliography of nightly observations of comet tails from astronomical literature over the past 70 years, concentrating on studies which include more than one photograph per night is presented. The bibliographies hopefully will provide the observational basis of a study of the short term behavior of comet tails. The references listed are by the name of the comet in chronological order. In addition to the usual bibliographic information, a short statement beneath each reference was designed to give an idea of the number of plates available over a certain time period; and the name of the observatory where the plates are located is included. L.S.

N66-17247*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LONG-TERM MOTION OF A LUNAR SATELLITE

Frances A. Frost Oct. 1965 29 p refs

(NASA-TM-X-55374; X-547-65-388) CFSTI: HC $2.00/MF $0.50 CSCL 22A

A harmonic analysis method is used for analyzing the long term motion of a lunar satellite. The Hamiltonian used is a long-period Hamiltonian in which the argument of pericenter and inclination of the satellite appear, but in which other angular variables have been eliminated. It includes the perturbation of the earth as a point mass, and the principal part of the moon oblateness. Solution of the Hamiltonian is presented; and tables are given listing the value for the mean motion of the satellite η^2 and the argument of the satellite pericenter g as functions of time. Greater accuracy may be achieved by retaining terms of the series after 8g or 8ψ. An advantage of this method is the ability to include the oblateness of the moon. This is especially advantageous when the lunar orbiter is near the moon, where the effect of the moon's oblateness is greater. L.S.

N66-17249*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY TRAJECTORY ANALYSIS OF A MARS PROBE
John Mc Nellis Oct. 1965 31 p ref
(NASA-TM-X-55376; X-643-65-390) CFSTI: HC $2.00/MF $0.50 CSCL 22C

This report investigates the feasibility of the needle-nosed probe which is proposed as an experiment on a 1969 Voyager fly-by bus. The probe is to be separated from the bus within 20 days prior to closest approach of the bus. It is to enter the Mars atmosphere and transmit atmospheric entry information back to the bus. Nine bus trajectories were used for generating probe trajectories. For a given bus trajectory a set of probe trajectories (meeting the required constraints) was computed. Each of the trajectories in the set corresponded to a different separation time of the probe prior to closest approach of the bus. For each probe trajectory the separation velocity vector was varied to develop a subset of probe trajectories (with different entry times) for each separation time. It is shown that by choosing the separation time sufficiently early (approximately 20 days prior to closest approach of the bus) the probe mission may be accomplished using a separation velocity under seven meters per second for all acceptable bus trajectories. Author

N66-17251*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TWO REFERENCE APOLLO LUNAR PARKING ORBITS
T. P. Timer Oct. 1965 24 p ref
(NASA-TM-X-55378; X-543-65-399) CFSTI: HC $1.00/MF $0.50 CSCL 22C

This report investigates the variation of the orbital parameters for the forty hour period after insertion into two reference Apollo Lunar Parking Orbits. It is found that while the variation of most of the parameters under the influence of a triaxial Moon and other perturbing forces is small, the change in pericynthion height is significant. The most pertinent piece of information derived from this investigation is with regard to the choice of hypothetical lunar landing sites on the surface of the Moon. Choosing a point on the earthward side of the trace which satisfies the constraint that it has a longitude of between 315° and 45° and a latitude of +5° and −5° with respect to a selenographic coordinate system one has a hypothetical landing site. It is found that any subsequent trace of the sub-module point at the same longitude will always lie within 0.5° in latitude of the initial landing site chosen during the forty hours under consideration. Therefore, landing sites chosen in the above manner meet the two requirements as described in Apollo Navigation Technical Report. Author

N66-17254*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LIFETIMES OF HIGHLY ECCENTRIC SATELLITES
Barbara E. Shute and Janice Chiville Oct. 1965 28 p refs
(NASA-TM-X-55381; X-643-65-402) CFSTI: HC $2.00/MF $0.50 CSCL 22C

Lifetimes of several high eccentricity satellites which are listed with question marks in King-Hele's tables have been obtained with more certainty by including the solar-lunar perturbations. Minimum lifetimes have been found for two satellites, EGO and Explorer XIV. The computations are indeterminate as to whether the lifetime will be equal to or greater than the minimum lifetime. Satellites of intermediate eccentricity ($0.4<e<0.7$) were shown to be affected by lunar and solar perturbations, but it is likely that they are simultaneously affected by atmospheric drag. These results are summarized in Table I. Author

N66-17259*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPUTATIONAL PROCEDURE FOR VINTI'S ACCURATE REFERENCE ORBIT WITH INCLUSION OF THE THIRD ZONAL HARMONIC
N. L. Bonavito Oct. 1965 24 p refs
(NASA-TM-X-55386; X-547-65-415) CFSTI: HC $1.00/MF $0.50 CSCL 22C

Vinti has recently modified his spheroidal potential so as to permit exact inclusion of the effects of the third zonal harmonic of the planet's gravitational field. This corresponds to a potential fitted exactly through the third zonal harmonic and about two-thirds of the fourth. The present paper treats the method for obtaining the position and velocity coordinates of a satellite moving in the field corresponding to this accurate modified potential. Author

N66-17260*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NUMERICAL DETERMINATION OF SHORT PERIOD TROJAN ORBITS IN THE RESTRICTED THREE BODY PROBLEM
Edson F. Goodrich Oct. 1965 27 p refs
(NASA-TM-X-55388; X-643-65-420) CFSTI: HC $2.00/MF $0.50 CSCL 22C

In the plane restricted three body problem, two classes of periodic orbits exist around the equilateral libration points. Rate developed methods for determining members of the class of long period orbits with Jupiter and the Sun as principal masses. This report demonstrates the use of these methods to examine the class of short period orbits. Knowledge of the value for the Jacobi constant gives approximate initial conditions for short period orbits near the libration points. An iteration scheme improves the initial conditions to periodic conditions. The Jacobi constant decreases as the orbit size increases and deviates farther from the libration point. The periods of all orbits differ by less than one percent from the period of Jupiter's motion around the Sun. Elliptical orbits around the Sun closely represent the short period orbits, and the eccentricities of these elliptical orbits approach unity as the deviations from the libration point increase. A linear stability study indicates instability for all orbits determined. Author

N66-17262*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INJECTION CONDITIONS FOR LUNAR TRAJECTORIES
Ronald Kolenkiewicz and William Putney Nov. 1965 48 p refs
(NASA-TM-X-55390; X-643-65-430) CFSTI: HC $2.00/MF $0.50 CSCL 22C

This paper reviews the mechanics of Earth to Moon trajectories as affected by geometric considerations and booster capabilities. It formulates and describes the equations for a computing procedure which, using the two body equations of motion, provides approximate initial injection conditions near the earth for either a fixed time of arrival at the Moon or a fixed time of flight to the Moon. Consideration of multiple circular parking orbits, arbitrary injection elevation angles, arbitrary launch site, and booster burning characteristics are also taken into account. The trajectory followed is an elliptical Earth to Moon transfer trajectory, with respect to the Earth, which intersects the Moon before apo-apsis. A digital computer program having the equations programmed in FORTRAN II is available. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N66-16188*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 5, NO. 23
15 Dec. 1965 26 p
(NASA-TM-X-57160; X-537-65-217) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Data on objects in orbit as of 1200Z on December 15, 1965 are presented. Code name, catalog number, source, launch date, period, inclination, apogee, perigee, and transmitting frequency are given. E.E.B.

N66-16578*# National Aeronautics and Space Administration, Washington, D. C.
A NETHERLANDS SATELLITE PROGRAM
C. de Jaget Jan. 1966 12 p Transl. into ENGLISH of the draft "Een Nederlands Satellietprogram" Utrecht, 31 Aug. 1965
(NASA-TT-F-9876) CFSTI: HC $1.00/MF $0.50 CSCL 22B

It is proposed to launch five Netherlands satellites during the next seven or eight years (by 1973). Three of these are a standard type for continuous observation of electromagnetic and particle radiation from the sun. One other satellite is spin-stabilized on the galactic level and is intended for stellar-astrophysical studies: the last one is to be a large stabilized solar-stellar satellite. Author

N66-16694*# Electro-Optical Systems, Inc., Pasadena, Calif.
ANALYSIS OF POTENTIAL SECONDARY EXPERIMENTS FOR A SOLAR THERMIONIC FLIGHT TEST VEHICLE. VOLUME IV: SPACECRAFT/EXPERIMENT PAYLOADS
Final Report, 14 May–15 Oct. 1965
19 Nov. 1965 23 p Prepared for JPL
(Contracts NAS7-100; JPL-951162)
(NASA-CR-70089; EOS-6961, Vol. IV) CFSTI: HC $1.00/MF $0.50 CSCL 22B

A typical experiment/spacecraft integration cycle for a solar-thermionic flight test vehicle is outlined. The integration cycle of the spacecraft is presented from an experimenter's point-of-view to serve as an example of the tests and procedures an experiment will experience between the time the experiment fabrication is complete and the spacecraft is launched. The types of equipment to be supplied, the tests to be performed, calibration of the experiment, launch site operations, and data processing are discussed. Three experiment payloads are described. Two of these payloads emphasize the power technology experiments. The third payload is a typical group of science experiments and is included to show flexibility of the spacecraft in accommodating experiments of different types. M.R.W.

N66-16695*# Electro-Optical Systems, Inc., Pasadena, Calif.
ANALYSIS OF POTENTIAL SECONDARY EXPERIMENTS FOR A SOLAR-THERMIONIC FLIGHT TEST VEHICLE. VOLUME I: SUMMARY Final Report, 14 May–15 Oct. 1965
19 Nov. 1965 49 p Prepared for JPL
(Contracts NAS7-100; JPL-951162)
(NASA-CR-70051; EOS-6961, Vol. I) CFSTI: HC $2.00/MF $0.50 CSCL 22B

This report contains a catalog of representative ancillary experiments of a scientific and engineering nature suitable for inclusion on experimental spacecraft. The experiment catalog is divided into the appropriate scientific disciplines and engineering technologies. The study includes consideration of the mission and spacecraft factors affecting the selection of experiments. Consideration is also given to the scientific merit, the practical merit, compatibility, and engineering value in the selection of the experiments contained in the catalog. These considerations, as well as the experimental spacecraft constraints are used to develop representative experiment payloads for three different specified missions. The details of the experiment payloads and the interface with the various spacecraft subsystems are discussed and summarized. The results of this study indicate that the JPL experimental spacecraft offers a flexible "bus" and mission concept on which many scientific and engineering experiments can be conducted. Author

N66-16708*# Boeing Co., Seattle, Wash. Aerospace Div.
ORBITAL LAUNCH FACILITY STUDY, VOLUME II-B Technical Report (Final)
Oct. 1965 537 p refs
(Contract NAS8-11355)
(NASA-CR-67823; D2-82559-2, Vol. II-B) CFSTI: HC $8.37/MF $2.50 CSCL 22A

The development program and design integration for the orbital launch facility (OLF) are discussed. The schedule, design, research, development, test, facilities, reliability, logistics, manufacturing, management, and funding plans are outlined and discussed. Special studies and experiments relating to OLF are also described. Structural configurations, mechanisms, and considerations for the OLF are given. Also outlined are the electrical power; guidance and navigation; attitude control and stabilization; environmental control and life support; crew support; checkout and monitoring; and data management and communications on-board systems for the OLF. A subsystems summary is presented. L.S.

N66-16709*# Boeing Co., Seattle, Wash. Aerospace Div.
ORBITAL LAUNCH FACILITY STUDY, VOLUME I Technical Report Summary (Final)
Oct. 1965 91 p refs
(Contract NAS8-11355)
(NASA-CR-67657; D2-82559-1, Vol. I) CFSTI: HC $3.00/MF $0.75 CSCL 22A

Background material associated with orbital-launch operations applications for the orbital launch facility, OLF, is summarized. The approach, results, and conclusions of the OLF study are briefly described. The design integration of the baseline, and on-board systems are outlined, and special studies relating to gravitational level analysis, and other experiments for the OLF are described. L.S.

N66-16710*# Boeing Co., Seattle, Wash. Aerospace Div.
ORBITAL LAUNCH FACILITY STUDY, VOLUME II-A Technical Report (Final)
Oct. 1965 211 p refs
(Contract NAS8-11355)
(NASA-CR-67736; D2-82559-2, Vol. II-A) CFSTI: HC $6.00/MF $1.25 CSCL 22A

A summary of the principal results and conclusions arising from the orbital launch facility (OLF) study, is presented; and recommendations for future activity are made. Also presented are the study plan, along with the guideline assumptions and ground rules; and the operational plans for OLF operations, maintenance, crew, spares, expendables, and logistics. L.S.

N66-16751# European Space Technology Center, Delft (Netherlands).
A SUMMARY OF THE L.C.T. DESIGN STAGE FOR THE ESRO I SATELLITE
17 Sep. 1965 42 p
(E1-01-127) CFSTI: HC $2.00/MF $0.50

The satellite will be launched in 1967 and will measure the energies and distributions of particles at high latitudes and the effects of the particles as shown by auroral phenomena and the composition of the ionosphere. Two telemetry systems are included: a low speed system operating continuously at 320 bits/sec with a tape recorder for data storage, and a high speed real-time system at 5120 bits/sec operated by command over the auroral region in order to yield measurements in fine detail. The spacecraft is approximately cylindrical in shape, 76 cm in diameter, and 133 cm in height. Two radial telescopic booms carry electron probes and an axial boom carries a spherical ion probe. The launch vehicle will be a Scout launch vehicle. E.E.B.

N66-16937*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POSTLAUNCH STRUCTURAL ANALYSIS OF ECHO II SATELLITE
Hossein Bahiman Washington, NASA, Feb. 1966 13 p
(NASA-TN-D-3170) CFSTI: HC $1.00/MF $0.50 CSCL 22B

Telemetered data from the Echo II (1964 04A) satellite revealed an unexpectedly high spin rate. An analysis was performed to estimate the effects of the resulting centrifugal forces. Calculations were made for the case of the axis orientation that would give the greatest distortion, namely, spin about the polar axis. It was discovered from these calculations that deviation from spherical shape was greatest at the beacons. The maximum deviation was estimated at about 3 inches with local wrinkling of a fraction of an inch in depth. Wrinkling of other areas of the satellite surface was postulated as a result of a shifting spin axis during the initial orbits. Author

N66-16964*# Boeing Co., Seattle, Wash. Aerospace Div.
ORBITAL LAUNCH FACILITY STUDY. VOLUME III: OLF STUDY RESEARCH AND TECHNOLOGY IMPLICATIONS REPORT Final Report
Oct. 1965 19 p refs
(Contract NAS8-11355)
(NASA-CR-67667; D2-82559-3; Vol. III) CFSTI: HC $1.00/MF $0.50 CSCL 22A

Research and technology implications are reported for an Orbiting Launch Facility (OLF) with capabilities beyond those of Gemini, Apollo, AES, and MORL. Recommendations for research projects are made in the areas of aeronautics, biotechnology and human factors, electronics and control, materials and structures, nuclear systems, and propulsion and power generation. Such studies will provide data for evaluating the various methods of initiating manned interplanetary and lunar ferry missions. M.W.R.

N66-17000# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LES-4 SPIN AXIS ORIENTATION SYSTEM
Edward A. Vrablik, William L. Black, and John L. Travis 1 Oct. 1965 21 p CFSTI:
(Contract AF 19(628)-5167)
(ESD-TDR-65-460; TN-1965-48; AD-624358) CFSTI: HC $1.00/MF $0.50

This report deals with the design of a satellite stabilization system to maintain the angular momentum of a spin stabilized satellite normal to the satellite's orbital plane. This orientation of the angular momentum allows a higher gain (narrower beam) antenna in the X-band communications link in the satellite. The stabilization system uses the Earth's magnetic field as a source of torque and requires no commands from the ground as all the error sensing components are satelliteborne. Author (TAB)

N66-17055*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
ORL EXPERIMENT PROGRAM, VOLUME B. PART IX: OPERATIONS TECHNIQUES AND ADVANCED MISSIONS SPACECRAFT SUBSYSTEMS
21 Feb. 1966 122 p refs
(Contract NASw-1215)
(NASA-CR-70351) CFSTI: HC $4.00/MF $1.00 CSCL 22B

An illustration is made of the application of a previously derived synthesis framework to construct an Orbital Research Laboratory (ORL) experiment program in support of operations techniques and advanced mission spacecraft subsystems. The objectives of the techniques and subsystems area are: to develop and flight validate operational techniques and procedures for the conduct of experiments and anticipated future missions, and to perform inflight validation and qualification of subsystems and components for future space missions to establish equipment suitability and design improvements. Consideration is given to the identification of selected knowledge requirements and the derivation of experiment requirements. These include equipment functional and supporting research requirements, and prospective orbital activities. Appendices include illustrative selected knowledge requirements and representative experiments. C.T.C.

N66-17078*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
ON THE ENGINEERING PORTION OF A RESEARCH PROGRAM TO DEVELOP A ZERO-g, DRAG-FREE SATELLITE AND TO PERFORM A GYRO TEST OF GENERAL RELATIVITY IN A SATELLITE Fourth Semiannual Status Report
Robert H. Cannon, Jr. and Benjamin O. Lange Nov. 1965 28 p refs
(Grant NsG-582)
(NASA-CR-70305) CFSTI: HC $2.00/MF $0.50 CSCL 22B

It is reported that research has reached a point where feasibility of the zero-g satellite concept has been established. Relative to this, major effort was devoted to developing a flight program that will be of scientific value and will also permit thorough flight evaluation of a zero-g satellite control system. It is also reported that engineering effort on the control system design, and its evaluation using an air cushion vehicle has continued. C.T.C.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N66-16189*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
THE PROBLEM OF LOW LEVEL WIND DISTRIBUTION
J. H. Deese and Coralee C. Whisenant [1964] 104 p refs Presented at the Structural Engr. Councils of Fla., 1st Ann. Conf., Tampa, 9 Nov. 1964
(NASA-TM-X-57159) CFSTI: HC $4.00/MF $0.75 CSCL 13M

The variation of wind with altitude at low levels is hypothesized to be a universal velocity defect law; the exponential Sherlock formula fitted to observed data and extended to high altitudes is unbounded. Data from Hurricane Cleo 1964 and Dora 1964 is included with data from nine other storm happenings. Averaging of observed data as V^2 function is suggested in lieu of arithmetic averaging of V; probabilities developed from V^2 statistic (observed anemometer readings) need be transformed in probability to the linear V statistic to obtain high confidence levels at the extremes. Technical comments are solicited to promote math model development. Author

N66-16205*# TRW Systems, Redondo Beach, Calif.
INVESTIGATION OF HIGH-SPEED IMPACT PHENOMENA, VOLUME II
S. F. Friichtenicht Dec. 1965 231 p refs
(Contract NASw-936)
(NASA-CR-69894; STL-4158-6015-SU-000) CFSTI: HC $6.00/MF $1.25 CSCL 20K

This volume of the final report on the investigation of high-speed impact phenomena contains the following appendices: *Solid-State Low Noise Preamplifier; High-Repetition-Rate Particle Injector for Electrostatic Accelerator; Velocity Selector for an Electrostatic Hypervelocity Accelerator; Particle Parameter Selection System for an Electrostatic Particle Accelerator; Solid-State High Voltage Pulser; A Novel High Voltage Generator; Electronic Particle-Parameter Analyzing Systems for an Electrostatic Hypervelocity Projector; Micrometeoroid Simulation Using Nuclear Accelerator Techniques; Ionization Associated with Hypervelocity Impact; Impact Ionization from Fragile Targets; Experiments on the Impact-Light-Flash at High Velocities; Response of Microphone Meteorite Detectors to the Impact of High Velocity Particles; The Interaction of Micrometeorites with Gaseous Targets; Penetration of Thin Films by Hypervelocity Micro-Particles; Solid-State Detector;* and *High Voltage Breakdown Initiated by Particle Impact.* E.E.B.

N66-16228# Naval Ordnance Lab., White Oak, Md. Underwater Explosions Div.
THE RESISTANCE OF HOLLOW GLASS MODELS TO UNDERWATER EXPLOSIONS AT GREAT DEPTHS. II: SPECIAL CONFIGURATIONS
W. H. Faux Jan. 1966 26 p refs
(NOLTR-65-146; AD-624498) CFSTI: HC $2.00/MF $0.50

Hollow glass models were exposed to explosions of one pound charges at several depths in the ocean down to 22,000 ft. Spheres coated with a plastic overlay or with butyl rubber were considerably stronger than bare spheres. Spheres with simple hatches and titanium plug inserts were somewhat weaker than unmodified spheres of slightly thicker glass. A depth-hardening effect was found for toroidal models; results obtained from cylinders were inconclusive. Author (TAB)

N66-16247*# Michigan Univ., Ann Arbor. Dept. of Engineering Mechanics.
THE ROLLING TIRE UNDER LOAD
Samuel K. Clark [1965] 14 p refs Presented at the Mid-Year Meeting of the Soc. of Automotive Engr., Chicago, 17-21 May 1965 *Its* Rept.-650493
(Grant NsG-344)
(NASA-CR-69998) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Methods are presented for calculating dynamic contact patch areas of an elastically supported cylindrical shell used to model the dynamic rolling of a loaded pneumatic tire. These areas are shown to be influenced considerably by rolling velocity, constructional parameters of the tire, and its loss characteristics. Dynamic pressure distributions within contact patch areas are obtained analytically, and the techniques involved are given. The shell is used as a basis for calculating load carrying and drag properties of a pneumatic tire so that various tire parameters may be approximated. The results given here are typical of information obtainable from such a model. Author

N66-16251*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
JUNCTURE STRESS FIELDS IN MULTICELLULAR SHELL STRUCTURES. VOLUME VIII: BUCKLING ANALYSIS OF SEGMENTAL ORTHOTROPIC CYLINDERS UNDER NON-UNIFORM STRESS DISTRIBUTION Final Technical Report
B. O. Almroth, F. A. Brogan, and E. V. Pittner Dec. 1965 35 p refs
(Contract NAS8-11480)
(NASA-CR-69995; M-77-65-8) CFSTI: HC $2.00/MF $0.50 CSCL 20K

This volume presents a solution to the buckling problem of orthotropic cylindrical panels under non-uniform axial compression. For such a case the governing differential equations cannot be separated with respect to the space variables and thus analytical solutions are not available. The total potential energy of the system is expressed in terms of the displacement components and their derivatives. The energy formulation is transformed into a rational function of the displacements at the mesh points of a finite-difference net. The adjacent equilibrium theory of buckling is used to define the critical load as the eigenvalue of a large matrix. Due to the fact that the finite-difference net has two dimensions, the degrees of freedom of the system is very large. Possible methods of solutions are therefore discussed with emphasis on computer economy. Author

N66-16321 Eidgenossisches Technische Hochschule, Zurich (Switzerland).
CONTRIBUTION TO THE THEORETICAL AND EXPERIMENTAL STUDY OF THE DEFORMATIONS OF A HORIZONTAL ELASTIC FOUNDATION USING A LAW OF SECOND APPROXIMATION [CONTRIBUTION A L'ETUDE THEORIQUE ET EXPERIMENTALE DES DEFORMATIONS D'UN SOL HORIZONTAL ELASTIQUE A L'AIDE D'UNE LOI DE SECONDE APPROXIMATION]
Michel Soldini Zurich, Verlag Leemann, 1965 95 p refs In FRENCH *Its* Publ. du Lab. de Photoelasticite no. 9

The deformation of an elastic horizontal foundation under a load is given by the partial differential equation

$$p(x,y) = \alpha \cdot w(x,y) - \beta\left(\frac{\delta^2 w}{\delta x^2} + \frac{\delta^2 w}{\delta y^2}\right)$$

where p(x,y) is the load measured by a unit of surface area, and where α and β are constants which are defined for particular cases. The conditions are delineated under which this equation is applicable; and solutions are offered for both two dimensional and three dimensional cases with various methods of loading. The results are compared with those given by experimentation with models and, in some cases, with those obtained from the theory of elasticity. Finally, theoretical justification is given both for the equation and the various values assigned to the constants. Transl. by D.T.

N66-16384*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
JUNCTURE STRESS FIELDS IN MULTICELLULAR SHELL STRUCTURES. VOLUME VII: BUCKLING ANALYSIS OF SEGMENTAL ORTHOTROPIC CYLINDERS UNDER UNIFORM STRESS DISTRIBUTION Final Report

E. V. Pittner, B. O. Almroth, and L. H. Sobel Jul. 1965 85 p refs
(Contract NAS8-11480)
(NASA-CR-69870; LMSC-M-77-65-3) CFSTI: HC $3.00/MF $0.75 CSCL 20K

This volume presents a theoretical solution to the buckling problem of orthotropic cylindrical panels under uniform axial compression. The panels are simply supported along the curved edges and elastically supported along the straight edges. There is included a digital computer program that was used to obtain design curves which give nondimensional buckling loads for a wide range of geometric parameters for the cylindrical panels. Derivation of the expressions for the bending influence coefficients of orthotropic rectangular plates is also included. Author

N66-16399# Lockheed Missiles and Space Co., Sunnyvale, Calif.
NATURAL VIBRATIONS OF SPHERICAL SHELLS
V. S. Gontkevich [1964] 11 p refs Transl. into ENGLISH from Issled. po Teorii Sooruzh (USSR), no. 13, 1964 p 77–83

Presented are results of theoretical and experimental studies of natural vibration frequencies in spherical shells. Approximate integrals for computations are disclosed and used to calculate the various vibration frequencies by the Rayleigh–Ritz method. In the case of a closed spherical shell, the integrals of the bending equations are Legendre functions with a real integer index whose values are easily computed. In the case of non-closed shells, approximation integrals for axisymmetric vibrations are utilized. There was good agreement between experimental and theoretical results. G.G.

N66-16470# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.
THE INELASTIC BUCKLING OF MACHINED HIGH STRENGTH STEEL HEMISPHERES WITH IDEAL BOUNDARIES Final Report
Kanehiro Nishida Sep. 1965 20 p refs
(DTMB-2090; AD-622432) CFSTI: HC $1.00/MF $0.50

Five structural models consisting of hemispheres bounded by ring-stiffened cylinders designed to provide membrane edge conditions where hydrostatically tested. The models were machined from high strength steel with yield strength of 130,000 psi and were designed to collapse by plastic instability. The experimental collapse pressures obtained are in good agreement with the pressures predicted by the Model Basin empirical inelastic buckling equation. The maximum difference obtained was 6 percent. Author (TAB)

N66-16494*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
PANEL FLUTTER AERODYNAMICS Final Report, 25 Jun. 1964–25 Sep. 1965
E. F. E. Zeydel [1965] 74 p refs
(Contract NAS8-11396)
(NASA-CR-69144) CFSTI: HC $3.00/MF $0.75 CSCL 20K

A new method for predicting in low supersonic flow the flutter boundaries for a very low aspect ratio rectangular flat panel is presented. The method is based on linearized, three-dimensional potential flow theory and small deflection plate theory. Only the simply supported edge condition has been considered, although other edge conditions can be treated in a similar manner. An analysis for the determination of the model parameters of a stationary wavy wall wind tunnel model is given. The design of a boundary layer probe to obtain adequate experimental information for the description of the velocity distribution and the pressure distribution within a turbulent boundary layer of variable thickness is also presented. The probe is sting supported and capable of traversing the boundary layer in three mutually perpendicular directions. Author

N66-16522# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.
POTENTIAL HULL STRUCTURES FOR RESCUE AND SEARCH VEHICLES OF THE DEEP-SUBMERGENCE SYSTEMS PROJECT, NOVEMBER 1964–FEBRUARY 1965
Martin A. Krenzke, Kenneth Hom, and John L. Proffitt Mar. 1965 60 p refs
(DTMB-1985; AD-614632) CFSTI: HC $3.00/MF $0.75

Tradeoff studies between pressure hull material, configuration, and buoyancy are performed for both the Rescue and the Search Vehicles of the Deep-Submergence Systems Project. Spherical, cylindrical, and spheroidal shells of high strength steels, titanium alloys, aluminum alloys, glass-reinforced plastics, glass, and ceramics are considered. Failure criteria are developed based on recent research findings. Potential pressure hulls for both vehicles are discussed and the need to develop light-weight floatation systems for the Search Vehicle is emphasized. Author (TAB)

N66-16546*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRUCTURAL CONCEPTS FOR HYDROGEN-FUELED HYPERSONIC AIRPLANES
L. Robert Jackson, John G. Davis, Jr., and Gregory R. Wichorek Washington, NASA, Feb. 1966 46 p refs
(NASA-TN-D-3162) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Two structural concepts have been identified and investigated to obtain a better insight into problems associated with structures for hydrogen-fueled hypersonic airplanes. One of these is the multiwall sandwich concept which combines the evacuated thermal protection, tankage, and load-carrying functions into a single component. The other concept is based on the use of an unsealed structure that does not require vacuum sealing, but rather utilizes carbon dioxide gas to purge the insulation space between the structure and tanks. A brief look at some characteristics of these two concepts and some analytical and experimental results related to the concepts are presented. Author

N66-16552*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRACTURE MECHANICS OF THROUGH-CRACKED CYLINDRICAL PRESSURE VESSELS
Robert B. Anderson and Timothy L. Sullivan Washington, NASA, Feb. 1966 35 p refs
(NASA-TN-D-3252) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The strength of cylindrical pressure vessels (with longitudinal through-cracks) is related to the geometry of the cylinder, the crack length, the material yield strength, and fracture toughness. An expression for the crack tip stress intensity factor is derived by considering the influence on the stress near the crack tip of membrane stressing in the cylinder and of bending caused by bulging of the partially constrained material on either side of the crack. The form of the derived expression is verified and empirical constants evaluated from burst data at −320° and −423° F of aluminum alloy (2014-T6 Al) and extra-low-interstitial (ELI) titanium alloy (5Al–2.5Sn–Ti) tanks. The analysis, based on the Irwin fracture theory, provides a suitable means for the correlation of the strength of

flat-sheet specimens with that of cracked pressurized cylinders. The correlation suggests that the fracture strength of through-cracked cylinders of any radius, crack length, and thickness can be determined from material toughness, yield strength, and a bulge coefficient. Neglect of the effect of pressure bulging in the fracture analysis of pressurized cylinders can cause a significant overestimate of the fracture strength. Author

N66-16590*# Northrop Space Labs., Huntsville, Ala. Research and Analysis Section.
INFLUENCE OF DAMPING AND MASS-STIFFNESS DISCONTINUITIES UPON THE DYNAMIC STABILITY OF A FREE-FREE BEAM UNDER A GIMBALED THRUST OF PERIODICALLY-VARYING MAGNITUDE Technical Memorandum No. 103
J. H. Kincaid, C. M. Pearson, J. L. Hill, and L. H. Wang [1964] 216 p refs
(Contract NAS8-11255)
(NASA-CR-70054; E20-117) CFSTI: HC $6.00/MF $1.25 CSCL 20K

This report considers the dynamic stability of a piecewise continuous beam accelerated through space by a gimbaled, pulsating end thrust and is in essence an investigation into the stability of transverse vibrations induced by the periodically-varying portion of the end thrust. A beam geometry and environment was assumed which could approximate a rocket vehicle. Initial conditions, damping, and longitudinal coupling effects were considered. The analysis was performed on a uniform beam and the method extended to include stepped beams. The results indicated that parametric instability could develop at arbitrarily small thrust values when damping was neglected. It was determined that damping eliminated instabilities which existed at near zero thrust values and that critical thrust parameters could be obtained. Results indicate that modern rocket vehicles could be unstable for some parameter combinations. Author

N66-16600*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
JUNCTURE STRESS FIELDS IN MULTICELLULAR SHELL STRUCTURES. VOL. IX: SUMMARY OF RESULTS AND RECOMMENDATIONS Final Report
E. Y. W. Tsui Dec. 1965 31 p refs
(Contract NAS8-11480)
(NASA-CR-70149; LMSC-M-77-65-9) CFSTI: HC $2.00/MF $0.50 CSCL 20K

This report summarizes the results of the bending and buckling analyses on juncture stress fields in multicellular shell structures and provides recommendations for possible future studies on the same subject. R.N.A.

N66-16610# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
EQUATIONS FOR THE PERTURBED MOTION OF A RIGID BODY WITH A CYLINDRICAL CAVITY PARTIALLY FILLED WITH LIQUID
B. I. Rabinovich Nov. 1965 21 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 2, 1946 p 39-50
(RSIC-476; AD-625517) CFSTI: HC $1.00/MF $0.50

Equations are derived for the perturbed motion of a rigid body with a cylindrical cavity, the axis of which is inclined by a small angle from the direction of the field of external mass forces. As a result, the equations of motion are simplified due to the elimination of certain sums containing an infinite set of terms. Author (TAB)

N66-16622# Brown Univ., Providence, R. I. Div. of Engineering.
AN EXPERIMENTAL INVESTIGATION OF ELASTIC-PLASTIC PULSE PROPAGATION IN ALUMINUM RODS AT ELEVATED TEMPERATURES
S. R. Bodner and R. J. Clifton Sep. 1965 40 p refs
(Contracts Nonr-562(20); ARPA SD-86)
(TR-44; AD-625468) CFSTI: HC $2.00/MF $0.50

Experiments are reported involving explosive loading at one end of long, annealed, commercially pure, aluminum rods at temperatures up to 75° F. The stress waves are detected by a condenser microphone at the far end of the rod and, in some cases, by strain gages at a cross-section distant from the impact end. The essential features of the recorded velocity-time profiles and strain-time profiles are in agreement with the predictions of a rate independent elastic-plastic theory which takes a Bauschinger effect into account. At room temperature, the reference dynamic stress-strain curve does not differ appreciably from the quasi-static stress-strain curve whereas at elevated temperatures there appears to be a marked difference between the dynamic and quasi-static stress-strain curves. Since the maximum plastic strains are small at cross-sections remote from the impact end the measurements, and consequently the conclusions, are limited to small strains beyond the proportional limit. Author (TAB)

N66-16623# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
HARMONIC WAVE PROPAGATION IN ELASTIC RODS OF ELLIPTICAL CROSS-SECTION
P. K. Wong, J. Miklowitz, and Richard A. Scott Nov. 1965 33 p refs
(Contract Nonr-220(57))
(TR-2; AD-625408) CFSTI: HC $2.00/MF $0.50

Using the potential equations of motion of linear elasticity, the propagation of harmonic waves in an infinite isotropic rod of elliptical cross-section is investigated. Three modes of motion are found to exist, corresponding to longitudinal, flexural, and torsional modes in a circular rod. The frequency equation for a flexural case is obtained in the form of an infinite determinant (set = 0), the elements of which involve Mathieu functions and their derivatives. It is shown that this determinant can be written in diagonal form when the eccentricity goes to zero. The diagonal elements describe the propagation of harmonic flexural and circumferential modes (of odd order) in a circular rod. Finally, some possible numerical procedures are discussed. Author (TAB)

N66-16627# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
ELASTIC PLASTIC ANALYSIS OF THE COLLAPSE OF UNIFORMLY COMPRESSED CIRCULAR CYLINDRICAL SHELLS
Tsai-Chen Soong and Nicholas J. Hoff Apr. 1965 58 p refs
(Contract AF 49(638)-1276)
(SUDAER-231; AFOSR-65-1587; AD-625276) CFSTI: HC $3.00/MF $0.75

A new geometric form is proposed as a large-displacement buckling pattern of a circular cylindrical shell of finite length simply supported at the ends and subjected to axial compressive load. Exact expressions are derived for displacements and membrane strains. They show that the new pattern is almost entirely free of membrane strain. During buckling plastic yield hinges are assumed to develop which form ridges separating the mostly flat buckled surfaces. The buckling load and the post-buckling load are calculated from the energy balance and from a compatibility condition of the displacements of test specimen and elastic testing machine. Author (TAB)

N66-16672# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

THE SNAP-THROUGH AND POSTBUCKLING-EQUILIBRIUM BEHAVIOR OF CIRCULAR CYLINDRICAL SHELLS UNDER AXIAL LOAD

Wayne A. Madsen and Nicholas J. Hoff Apr. 1965 77 p refs (Contract AF 49(638)-1276)

(SUDAER-227; AFOSR-65-1588; AD-625275) CFSTI: HC $3.00/MF $0.75

The analysis was begun with an investigation of the effect that a more accurate displacement assumption, in conjunction with the exact strain-displacement relations, has on the postbuckling equilibrium behavior. It was hoped that the limiting behavior of wall thickness and wave number parameter would be altered, and that the stress coefficient would not tend to zero. Particular attention was given to an exact representation of membrane strains because it was known that in the limit as the radius-to-thickness ratio of the shell approaches infinity, the displacements approach the inextensional polyhedral surface. While all the strains in the middle surface of this limiting polyhedral shell are zero, the Donnell strain-displacement relations yield strains amounting to 0.1% if the number of waves around the circumference is 10. The results obtained did not differ significantly from the Donnell strain-displacement relations. Author (TAB)

N66-16707*# TRW Systems, Redondo Beach, Calif.

INVESTIGATION OF HIGH-SPEED IMPACT PHENOMENA (III), VOLUME I

J. F. Friichtenicht Dec. 1965 44 p refs (Contract NASw-936)

(NASA-CR-70032; STL-4158-6015-SU-000) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Facilities, equipment, techniques, and experimental procedures developed for investigating high-speed impact phenomena are described. Descriptions are given of an electrostatic accelerator; a charged-particle injector; several detectors; and mass and velocity ranges. Also discussed are high-repetition-rate particle injection; a velocity selector; a particle-parameter selection system; and automatic and semi-automatic methods of data analysis. Applications and experiments discussed are transient effects of high-speed impact; meteor simulation; hypervelocity impacts; micrometeoroid detection; and other miscellaneous applications. A comprehensive discussion of the accelerator facility, and measurement techniques common to all the experiments are given. An annotated bibliography of formal publications arising from or related to the research efforts is included. L.S.

N66-16721*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

JUNCTURE STRESS FIELDS IN MULTICELLULAR SHELL STRUCTURES. VOLUME V: INFLUENCE COEFFICIENTS OF SEGMENTAL SHELLS

P. Stern and C. T. Chen Aug. 1965 51 p ref (Contract NAS8-11480)

(NASA-CR-70016; M-77-65-6) CFSTI: HC $3.00/MF $0.50 CSCL 20K

This volume presents a technique using the modified digital programs developed for intermediate loads or thermal gradients to determine stiffness influence coefficients of cylindrical, conical and spherical shell segments. The problem is solved numerically by the finite difference method, using a direct method for solving a large system of simultaneous equations. For completeness as a self-contained report, a portion of the information presented in Vol. II, III and IV is repeated here. Author

N66-16744# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

THEORETICAL CONSIDERATIONS OF PANEL FLUTTER AT HIGH SUPERSONIC MACH NUMBERS

John Dugundji Aug. 1965 79 p refs (Contract AF 49(638-1528)

(ASRL-TR-134-1; AFOSR-65-1907; AD-624995) CFSTI: HC $3.00/MF $0.75

The general characteristics of panel flutter at high supersonic Mach numbers are examined theoretically. Linear plate theory and two-dimensional first order aerodynamics are used. The report attempts to clarify the important role of damping, the relationship between traveling and standing wave theories of panel flutter, and the effects of edge conditions. The solution procedures and general mathematical behavior may be of interest in other stability problems characterized by the appearance of complex eigenvalues. Author (TAB)

N66-16761# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.

COMMENTS ON AN ITERATION PROCEDURE FOR THE LARGE DEFLECTION ANALYSIS OF INITIALLY FLAT MEMBRANES

Allan B. Pifko and Martin A. Goldberg Jun. 1964 31 p refs (RM-232)

The large deflection of a uniformly loaded annular membrane, fixed at the outer boundary and free of traction and support at the inner boundary, is investigated by means of an iterative technique and a power series representation. The resulting solutions are compared in order to demonstrate the accuracy and convergence of the iterative procedure. Agreement between the second iteration and the more accurate series solution is shown to be very good. Author

N66-16815# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE RATE OF SPREADING OF FATIGUE CRACKS

Yu. D. Sofronov 19 Nov. 1965 23 p refs Transl. into ENGLISH from Tr. Kazansk. Aviats. Inst. (Kazan), no. 77, 1963 p 130–147

(FTD-MT-64-434; AD-624758) CFSTI: HC $1.00/MF $0.50

Data of tests show that fatigue crack may develop during stresses considerably below the fatigue limit. These exists a minimum value of amplitudes of oscillations, below which fatigue crack does not spread. The history of the loadings and the magnitude of overload up to the moment of formation of the crack practically do not affect the rate of its spreading. The established law-governing principles are verified by experimental data. The terminal period in development of crack does not obey the principles being proposed. As a result of processing the experimental data law-governing principles of the spreading of fatigue cracks are obtained. Author (TAB)

N66-16922*# National Aeronautics and Space Administration. Washington, D. C.

LOCAL STABILITY OF SANDWICH SHELLS OF REVOLUTION [LOKAL'NAYA USTOYCHIVOST' TREKHSLOYNYKH OBOLOCHEK VRASHCHENIYA]

E. I. Grigolyuk and P. P. Chulkov Feb. 1966 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. i Mashinostr., no. 6, 1964 p 78–88

(NASA-TT-F-412) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Extensive literature is devoted to the stability of sandwich shells; instances of the symmetric structure of shell thickness in shells with a lightweight core have been investigated in considerable detail. The discussion of these studies is a separate task in itself. Here are presented the results of a study

of the linearized stability of sandwich shells with asymmetric structure and a rigid core (shell of revolution, spherical, cylindrical, and conical shells) under compound stress. Definite results are obtained on the basis of a specific case. Author

N66-16928# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Flugzeugbau.
BUCKLING MODES OF ORTHOTROPIC CIRCULAR CYLINDERS UNDER AXIAL COMPRESSION FOR VARIOUS COMBINATIONS OF STIFFNESS PARAMETERS
H. Appel Aug. 1965 31 p refs
(DLR-FB-65-47) CFSTI: HC $2.00/MF $0.50

In the present paper the buckling behavior of ideal circular, orthotropic, thin-walled cylinders under axial compression has been investigated. It has been distinguished between chessboard buckling, ring buckling and longitudinal buckling, where longitudinal buckling corresponds to a buckling mode having one axial half wave. From the classical buckling condition (Donnell's theory) a criterion for the type of buckling is obtained for all possible combinations of stiffness parameters. The investigation excludes the case of column-buckling for very long cylinders and the influence of edge restraints for short cylinders. Author

N66-16977*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
JUNCTURE STRESS FIELDS IN MULTICELLULAR SHELL STRUCTURES. VOLUME VI: ANALYSIS OF MULTICELLULAR PROPELLANT PRESSURE VESSELS BY THE STIFFNESS METHOD Final Report
C. T. Chen and P. Stern Nov. 1965 31 p ref
(Contract NAS8-11480)
(NASA-CR-70187; M-77-65-7) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A technique is presented to set up and solve the boundary-value problem of structures composed of shell elements. The problem is formulated from the standpoint of transformations of coordinate systems, the compatibility and equilibrium requirements at the junctures and the solution of a large set of algebraic equations. The technique, known as the direct matrix stiffness or displacement method, is introduced to the multicellular shell structure to predict the stresses and deformations due to applied loads and thermal gradients. It is shown that the coupling and ordering of equations plays an important role in forming a desirable overall banded matrix. An example which demonstrates the practicability of the method is given. A digital program designed for the juncture matching has been developed. Although this program is not sophisticated, it can be used for a complete juncture problem. Author

N66-17016# Lockheed Missiles and Space Co., Sunnyvale, Calif.
BUCKLING STRENGTH OF CURVED BERYLLIUM PANELS IN COMPRESSION
M. J. Rebholz [1964] 32 p refs Presented at the Intern. Symp. on Beryllium Met. and Technol., Philadelphia, 15–17 Oct. 1964
(Contract AF 04(695)-191)
(AD-624644) CFSTI: HC $2.00/MF $0.50

The panel tests described were part of a development program for the use of beryllium. The forward structure of the Agena spacecraft was redesigned to use cross-rolled beryllium sheet as structural panels. Three different methods were used to fabricate twenty unstiffened and three stiffened, curved, beryllium panels. These panels were tested under axial compression loading to determine their critical buckling stress and to verify the design analysis. The paper presents test results and compares them with analytical values found by a semi-empirical method developed in recent NASA studies.
Author (TAB)

N66-17027# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
TURBULENCE-INDUCED PANEL VIBRATION
M. Y. el Baroudi Feb. 1964 98 p refs
(Contract AF 49(638)-249; Grants AF-AFOSR-62-267; DRB-9551-02)
(UTIAS-98; AFOSR-64-0883; AD-448045)

Motivated by the problem of boundary-layer induced panel noise, a detailed study has been made of the transverse vibration of 11 × 11 inch steel panels flush-mounted in the wall of a turbulent flow duct. Panel thicknesses were .002 and .008 inch. Duct cross sections were 1 × 12 and 8 × 12 inches, and flow speeds were about 60 to 200 feet per second. The characteristics of the exciting pressure field at the wall and of the resultant vibration of the sample panels were investigated using statistical techniques. Relief charts of the experimental two-point space-time correlation of panel vibration versus longitudinal separation and time-delay showed pronounced oblique ridges and valleys discernable in a more random pattern. These are interpreted as running waves (with a speed equal to that of the pressure field convection) with an irregular pattern superposed. Such running waves were predicted by Ribner's idealized infinite-panel model of the flexural response. On the other hand, a superposition of stationary unsteady oscillations in the various modes of a finite panel forms the basis of the more realistic but more complex theories. To test the compatibility, Dyer's idealized theoretical model of the panel response was developed and programmed for a digital computer. The calculated relief plot of correlation showed qualitative agreement with the experimental results. Author

N66-17081*# Illinois Univ., Urbana.
THEORETICAL AND EXPERIMENTAL STUDY OF THERMAL CONTACT RESISTANCE IN A VACUUM ENVIRONMENT Semiannual Status Report No. 8, Jun.–Dec. 1965
A. M Clausing 7 Jan. 1966 31 p refs
(Grant NsG-242)
(NASA-CR-70339) CFSTI: HC $2.00/MF $0.50 CSCL 20K

An investigation was made to remove the restrictions present in a previously developed model which predicts thermal contact resistance, and to better understand the basic mechanisms of this resistance. Descriptions are given of examinations made relative to the thermal contact resistance problem, this being treated in two parts: (1) given the contact geometry, determine the additional thermal resistance due to the presence of the interface and (2) given the specimen geometry and load, determine the contact areas. Preliminary results from analytical studies which show the influences of microscopic resistances on the macroscopic constriction resistance are described, and formulations for the extension of the model to include an interstitial substance are given. Included are results of resistance calculations for two dimensional plane constrictions. C.T.C.

N66-17094*# Chrysler Corp., Detroit, Mich. Missile Div.
RESEARCH AND INVESTIGATIVE ANALYSIS USING KRON'S METHOD OF ANALYZING REDUNDANT STRUCTURES
J. D. O'Rourke and C. Rydz 1 Nov. 1962 339 p refs
(Contract NAS8-5000)
(NASA-CR-70332; ADB-TN-29-62) CFSTI: HC $7.00/MF $1.75 CSCL 20K

An analysis was made to determine the response characteristics, frequency, and mode shape of the Saturn SA-D1 vehicle with particular emphasis on the booster section. A complete description of the analysis technique first proposed by Kron is provided. This describes the underlying theory of the analysis and the governing equations as programmed on

the digital computer. In addition, the mathematical model of the Saturn vehicle is discussed. The subsequent computer runs involving this mathematical model are used to establish seven predominant frequencies, and five of these are compared to the results of a test program conducted on this vehicle.
C.T.C.

N66-17107*# Michigan Univ., Ann Arbor. Tire and Suspension Systems Research Group.
THE CONTACT OF CERTAIN ELASTIC SHELLS WITH RIGID FLAT SURFACES Technical Report No. 3
Delmar H. Robbins Sep. 1965 104 p refs *Its* Rept.-05608-7-T
(Grant NsG-344)
(NASA-CR-70333) CFSTI: HC $4.00/MF $0.75 CSCL 20K

Various stresses and deformations occurring in certain simple symmetric shells which are forced into contact with rigid flat surfaces are considered. Shear deformation was included in the governing equations of linear, small deformation shell theory under the premise that the rapid changes of curvature which may occur near the contact region might lead to significant shear stresses and strains. It has been shown that a possible means for analyzing such problems involves the solving of the system equations separately in the free region and in the contact region. The two solutions are then matched at the common boundary at the edge of the contact region. This method has been applied to contact problems involving half-rings and spherical caps. Numerical results show that the effect of shear deformation should not be neglected when the radius-to-thickness ratio is 10 or less. Experiments performed on rubber half-rings tended to verify the shear-deformation analysis.
Author

N66-17220*# Rice Univ., Houston, Tex. Dept. of Geology.
TENSILE FRACTURE ALONG A BIMATERIAL INTERFACE
L. Mansinha [1964] 30 p refs Submitted for Publication
(Grant NsG-6)
(NASA-CR-60708) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The conditions for the existence of tensile fracture along a bimaterial interface have been determined by an extension of Yoffe's method. The velocity of such a fracture is specified by the combination of elastic properties of the two media. The fracture can move only at the specific velocity, without acceleration or deceleration. The maximum possible velocity of a fracture along an interface is the lower of the two Rayleigh wave velocities. The relative displacements on either side of the fracture surface depend on the velocity of the fracture as well as the combination of elastic properties. Several curves are presented showing the relationship between the elastic constants of the two media and the corresponding fracture velocity. A critical relation between the Poisson's ratio and shear moduli of the two media has been given. If this relation is satisfied, catastrophic failure cannot occur along the interface.
Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N66-16188*# Oklahoma State Univ., Stillwater. School of Mechanical Engineering.
[SPACECRAFT TEMPERATURE CONTROL BY THERMOSTATIC FINS] Progress Report, 1 Jun.-30 Nov. 1965
J. A. Wiebelt and D. Maples Dec. 1965 11 p refs
(Grant NsG-454)
(NASA-CR-69877) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Progress is reported on the study to examine analytically and experimentally the feasibility of using movable fins on a surface for spacecraft temperature control. A small space simulator was constructed with the basic container of stainless steel 24 inches in diameter and 48 inches long. A liquid nitrogen cooled liner 18 inches in diameter and 27 inches long was mounted inside the chamber. The chamber is evacuated using one six-inch oil diffusion pump with a low temperature baffle. The thermostatic fin system as originally conceived appears to react unfavorably in the presence of solar irradiation. An attempt to avoid this problem which is being considered is shown. Testing of the modified temperature control system is discussed. A fin system with two-inch fins on two-inch spacing with as-received fin surfaces was prepared for testing. This model was six-inches square as compared to a previous one foot square model. Also, a second thermostatic fin model with one-inch fins and one-inch spacings is under preparation.
E.E.B.

N66-16255# AiResearch Mfg. Co., Los Angeles, Calif.
FLOW DISTRIBUTION STUDY FOR A ROTARY REGENERATOR Final Report, 22 Sep. 1964-21 Jun. 1965
H. H. Walters and S. T. Jakubowski Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1965 245 p refs
(Contract AF 18(600)-2788)
(L-9492; AD-623843) CFSTI: HC $6.00/MF $1.25

The study provides an evaluation by means of analysis and experimentation for achieving proper flow distribution to highly compact surface densities—densities in excess of 2000 sq. ft./cu. ft. Heat transfer matrix analyses were performed to give an indication of the face area requirements and flow lengths for representatives rotary regenerator applications. Aerodynamic analyses were conducted to establish the optimum ratio between hot and cold gas rotary regenerator frontal areas. Aerodynamic analyses were performed to derive preliminary contoured shape configurations to give uniform distribution through the selected matrices. These analyses provided preliminary concepts for an experimental program. Definition of an experimental program included design and fabrication of all necessary experimental laboratory hardware, heat transfer matrices and the necessary flow directing devices along with proper implementation of required instrumentation. The experimental air flow runs were conducted using plain screen matrices, i.e. matrices without flow directing devices, which had air face to air frontal area ratios as follows: 1:1, 3:1, 6:1, and 9:1. Each run provided experimental data for three or more different air flow rates. Further experimental air flow runs were conducted using above cited matrices in conjunction with 25 different vane configurations. Again each run provided data for 3 or more different air flow rates. A computer program was established to reduce experimental data and to plot curves.
Author (TAB)

N66-16265# Dynamic Science Corp., Monrovia, Calif.
COMBUSTION INSTABILITY Final Technical Report
[1962] 77 p refs
(Contract AF 49(638)-1151)
(SN-1800; AFOSR-65-1683; AD-623847) CFSTI: HC $3.00/MF $0.75

The principle objective of the program was to relate combustion stability to injector design variables through a consideration of droplet dynamics and combustion. The basic

model treats the individual droplets as energy and mass sources. Stability or instability is determined by the relationship between energy and mass addition and the characteristics of the chamber or of a disturbance introduced into the chamber. Depending upon such relationships, a disturbance will be either amplified or dumped. A determination of the stability of a system will depend not only upon the frequency response of the energy and/or mass source but may also depend upon its spatial relationship. One of the first efforts in the study was to determine whether propellant droplets would assume specific patterns with respect to a disturbance and whether these patterns could affect the stability of the combustion process. TAB

N66-16378*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Aerospace Sciences Lab.

COUPLED CONVECTIVE AND RADIATIVE HEATING TO SUPERORBITAL ENTRY VEHICLES

A. C. Buckingham and H. Hoshizaki Oct. 1965 104 p refs (Contract NAS7-295)

(NASA-CR-69869; LMSC-4-43-65-1) CFSTI: HC $4.00/MF $0.75 CSCL 20M

Results of theoretical studies on the coupled radiative and convective heating for superorbital entry conditions are presented. The velocity range is $30 \leq U_\infty(K\text{-fps}) \leq 50$. The altitude range is $150 \leq F_\infty(K\text{-ft}) \leq 250$. Geometries analyzed consisted of hemisphere-cones with varying cone-frustrum half angles, paraboloids, and power law bodies generated by a hybrid half-power equation. The analytical profiles generated had continuously diminishing body curvature. The results are given as correlations of digital computer results. Simple algebraic relations for the convective and radiative distributions are developed. These relations are in turn integrated over surface area for the geometries studied. Graphs and polynomial curve fits of the integrals are given in addition to the correlation equations. Also presented are results of applications of the equations made for entry conditions within the range of validity of the correlations. Author

N66-16416# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE COMPUTATION OF HEAT TRANSFER IN THE BASE REGION

G. I. Maikapar [1965] 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. (Moscow), no. 5, 1965 p 144–146

Heat transfer in the base of bodies flying at supersonic velocities is computed by determining the inviscid flow in the stagnation region. A diagram of the body in question is given, with the flow regions surrounding the body being labelled. The flow near the base is considered to be laminar; and the flow with a surface S (shown) consists of the flow of an inviscid fluid and its adjoining boundary layer. The surface S is a surface of zero longitudinal velocity component, and coincides with the surface separating the outer and inner flows only at the boundaries of the stagnation region. The general method of computing flows with high enough Reynolds numbers is extended to the stagnation region. The problem of computing the inviscid fluid flow in the stagnation domain is reduced to the determination of the stream function within a wedge- or cone-shaped domain, and this problem is solved by using series. Examples are shown for plane flow, and axisymmetric flow cases. L.S.

N66-16449# Martin Co., Baltimore, Md.

RADIATING AND ABSORBING STEADY FLOW OVER SYMMETRIC BODIES

K. C. Wang Dec. 1965 51 p refs (RR-73)

This work presents an approximate nonlinearized solution of a multidimensional radiating and absorbing steady flow over smooth symmetric bodies, pointed or blunt, straight wall or curved. It is an extension of the same problem previously considered in the transparent limit. Using a series expansion in the density ratio across the shock, the multidimensional differential approximation for radiative transfer is reduced to a locally one-dimensional form normal to the body surface in the zeroth approximation. Zeroth order solutions of the radiation-convection coupled fields are then obtained; flows over a wedge, cone and sphere are discussed in detail as specific examples. Similar results previously obtained for an unsteady piston problem show satisfactory agreement with exact solutions. Author

33

N66-16511# Army Missile Command, Huntsville, Ala.

RADIANT ENERGY FLUX BETWEEN TWO PARALLEL, CONCENTRIC DISKS USING AN INTEGRAL METHOD

Noah J. Hurst and V. Wayne Sparks Sep. 1965 45 p (RS-TM-65-5; AD-474395)

Presented in this report are analyses and results of a problem of radiant energy exchange between two plane circular, parallel plates having a common central normal and existing in a totally absorptive, zero degree Kelvin environment. Equation are given to show the relation between the radiant energy flux and the radial surface distance from the center of the disk. Cases of the net heat exchange between one disk of finite radius and the other of varying radial position are determined for the different emissivities, temperatures, and spacing ratios of the two plates as functions of the ratio of radial surface distance outward to total radius of the disk. Graphs of the dimensionless energy flux versus the dimensionless ratio of radial surface distance outward to total radius of the disk, and the net heat exchange between the two parallel disks as a function of the position on one plate are presented for several values of emissivity and ratios of absolute temperatures with the spacing ratio as a parameter. Author (TAB)

N66-16553*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL PRESSURE DROP INVESTIGATION OF WETTING AND NONWETTING MERCURY CONDENSING IN UNIFORMLY TAPERED TUBES

James A. Albers and Henry B. Block Washington, NASA, Feb. 1966 34 p refs

(NASA-TN-D-3253) CFSTI: HC $2.00/MF $0.50 CSCL 20M

In general an overall static pressure rise was obtained for both wetting and nonwetting conditions at the weight flows and condensing lengths considered. At a mass flow rate of 0.028 pound per second, the overall static pressure difference was approximately equal for the wetted and nonwetted condensers; at mass flow rates of 0.038 and 0.049 pound per second, nonwetted flow exceeded that for wetted flow by a pressure rise of 0.3 and 0.6 pound per square inch, respectively. This pressure difference between nonwetted and wetted flows was significant compared with the overall pressure recovery. The Lockhart–Martinelli correlation agreed with the data for qualities greater than 0.4. For qualities less than 0.4 the frictional pressure gradient was greater than that predicted by Lockhart–Martinelli, and the deviation increased with an increase in the parameter χ. The fog-flow correlation of Koestel agreed with the nonwetted and wetted data for qualities greater than 0.4 although the frictional pressure gradients were slightly higher than those predicted by theory. Author

N66-16564*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ZERO-GRAVITY AND REDUCED-GRAVITY SIMULATION ON A MAGNETIC-COLLOID POOL-BOILING SYSTEM

S. Stephen Papell and Otto C. Faber, Jr. Washington, NASA, Feb. 1966 19 p refs

(NASA-TN-D-3288) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Magnetic body forces were used to counteract the influence of Earth gravity on a stable colloidal magnetic fluid. The weight of the fluid was reduced in a magnetic gradient oriented parallel but opposed to the Earth-gravity vector. Proper control of the magnitude of the gradient subjected the fluid to discrete values of effective accelerations between nearly zero and Earth gravity. Steady-state, saturated nucleate pool-boiling data were obtained at the various body force loadings. Changes in the boiling curves, attributed to buoyancy force effects, were observed in the critical-heat-flux region and the boiling incipience region. The critical heat flux dropped 15 percent when the acceleration field was changed from Earth gravity to nearly zero gravity. At the same time, the temperatures of the heat-transfer surface at the incipience boiling point dropped about 5° F (2.78° C). Explanations for this phenomenon were made in terms of the sensitivity of the thermal-layer thickness to the gravity field. Comparisons made with critical-heat-flux data, including the present and reference data, showed a divergence of 68 percent at nearly zero gravity. Author

N66-16569*# Pratt and Whitney Aircraft, East Hartford, Conn.

VAPOR-CHAMBER FIN STUDIES First Quarterly Report, May 28–Aug. 28, 1965

L. Langston and H. R. Kunz Sep. 1965 85 p refs

(Contract NAS3-7622)

(NASA-CR-54882; PWA-2698) CFSTI: HC $3.00/MF $0.75 CSCL 13A

This report describes an experimental and theoretical program formulated for obtaining an understanding of the operation of vapor-chamber fins. Results of this program should enable the application of this device to various proposed uses. A mechanistic model and a simplified analysis of fin operation are derived. This model indicates that experimental data is necessary on the permeability, capillary rise, and boiling in fin wicks before an understanding of fin operation can be obtained. Experiments are therefore defined to obtain these quantities. Permeability will be determined by measuring the pressure drop as a function of liquid flow rate through wick specimens. Capillary rise will be determined by measuring the maximum static height that a liquid will rise in a wick. Boiling tests will determine the maximum heat flux density that can be added to liquid-filled wicks before film-boiling occurs. Descriptions of the experimental apparatus to be used in each of these tests are presented. The manner in which the results from these tests will be used to define fin operating characteristics is indicated. Author

N66-16586*# LTV Aerospace Corp., Dallas, Tex. LTV Astronautics Div.

RESULTS OF HEAT TRANSFER TESTS ON SHARP AND SPHERICALLY BLUNTED 4° HALF ANGLE CONICAL MODELS IN A PLASMA JET AND IN A HYPERVELOCITY WIND TUNNEL

J. C. Hester and D. M. Martin 17 Dec. 1965 67 p refs

(Contract NAS1-3915)

(NASA-CR-66040; LTV-00.725) CFSTI: HC $3.00/MF $0.75 CSCL 20M

Heat transfer tests were conducted at high Mach numbers (14 to 17) in a hypervelocity wind tunnel at Reynolds numbers per foot from 0.1×10^6 to 3×10^6 and at high heating rate conditions on ATJ graphite models at Mach number 3 in a plasma arc facility. The data are shown to compare well with existing theories if the effects of various interaction and slip flow are considered. The data are also compared with previous heating results deduced from mass loss rates in the plasma facility and the results are found to be compatible. Based upon the results of these tests, a theory is postulated which predicts that a pointed tip will remain pointed so long as the distance from the tip to the point where continuum effects begin is much greater than the nose radius. Author

N66-16594*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ION BOMBARDMENT AND ITS EFFECTS ON THE OPTICAL PROPERTIES OF METALS

Donald L. Anderson [1963] 23 p refs

(NASA-TM-X-57174) CFSTI: HC $1.00/MF $0.50 CSCL 20M

An experimental program was conducted to determine the effects of ion bombardment on the total hemispherical emittance and solar absorptance of three engineering metals. The metals selected were a titanium alloy, a 99.99% pure aluminum, and electrolytic copper. They were selected because they are representative of structural metals used in the temperature control surfaces of space vehicles. The test equipment consisted of a sputtering apparatus, an integrating sphere reflectometer, and an emittance measuring apparatus. The principle of cathode sputtering was used to bombard the metallic specimens with normally incident ions of hydrogen gas at an energy level of 1000 electron volts. The procedures for sputtering the specimens and for determining their emittances and absorptances are described. The investigations showed that emittance, absorptance, and α/ϵ ratio of the materials tested are changed by ion bombardment. The resultant temperature variations could present a serious problem if such metals were used in temperature sensitive components or experiments in a space vehicle exposed to the high energy particles of the space environment. R.N.A.

N66-16625# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

REVIEW OF THEORETICAL ANALYSES OF ARC HEATING IN A TUBE

James G. Skifstad Oct. 1965 52 p refs

(ARL-65-207; AD-625558) CFSTI: HC $3.00/MF $0.50

The analytical methods utilized to compute the mutual interaction between a dc arc and a gas flow passing concurrently through a duct are reviewed and critically discussed. The numerous approximate and exact solutions for the fully-developed flow are presented in tabular form for reference purposes. Recent methods for solving the inlet flow problem are discussed, including the use of approximate laminar boundary layer methods and the exact numerical method. A new approximate solution is presented for an arc whose boundary is a paraboloid of revolution: the energy equation then reduces to a hypergeometric form. Evidence is presented showing that the results of computations for dc arcs may be in reasonable agreement with experimental data, notably the integrated parameters such as arc voltage, the development length, etc. The existing methods for describing similar situations, but with ac arcs are also reviewed. It is pointed out that one might expect an oscillatory coupling between the flow and the power input at certain frequencies, resulting in resonances and possibly standing waves in the tube. Certain open problems concerned with the interaction of an arc and a coaxial gas flow are presented in conclusion. Author (TAB)

N66-16631# Oklahoma Univ., Norman.
RADIATIVE HEAT TRANSFER BETWEEN PARALLEL PLATES SEPARATED BY A NON-ISOTHERMAL MEDIUM WITH ANISOTROPIC SCATTERING Technical Report, Feb. 1964-Mar. 1965
Tom J. Love and Han Min Hsia Wright-Patterson AFB, Ohio, ARL, Oct. 1965 106 p refs
(Contract AF 33(657)-8859)
(ARL-65-211; AD-625203) CFSTI: HC $4.00/MF $0.75

The problem of radiative heat transfer is considered for the case of partially reflecting parallel plates separated by an emitting, nonisothermal medium which scatters radiant energy in an anisotropic fashion. Both linear and parabolic temperature profiles are considered. The solutions are obtained by representing the integral term of the transport equation by a quadrature. The resulting set of non-homogeneous differential equations are solved by a method utilizing idempotents. Application of this method to problems involving spherical enclosures is discussed. Author (TAB)

N66-16747*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LAMINAR BOUNDARY-LAYER HEAT TRANSFER FROM A PARTIALLY-IONIZED MONATOMIC GAS BY THE SIMILARITY APPROACH
L H. Back 1 Feb. 1966 31 p refs
(Contract NAS7-100)
(NASA-CR-70035; JPL-TR-32-867) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Laminar boundary-layer heat transfer from a singly-ionized monatomic gas to a highly cooled wall, with no applied external electric or magnetic fields, is analyzed by the similarity solution approach. The gas is assumed to be electrically neutral with ambipolar diffusion by ion–electron pairs. In addition, equal electron and atom–ion temperatures are assumed, and sheath effects are not considered. From existing perfect gas similarity solutions, the number of parameters that need to be investigated is reduced to those directly related to ionization effects. Solutions for the limiting cases of a large diffusion rate compared to the net production rate of ions, and for local equilibrium, are obtained for constant Prandtl number and a range of Lewis numbers. An approximate prediction method is then suggested to account for variable free-stream velocity and ionization effects in a flow over a highly cooled wall.
Author

N66-16926 Joint Publications Research Service, Washington, D. C.
PRINCIPLES AND METHODS OF RATIONAL THERMODYNAMICS
H. de Beaumont et al 2 Feb. 1966 65 p Transl. into ENGLISH from Ed. Ind. Tech. et Lit. (Paris), 1954 p 1–47
(JPRS-33962; TT-66-30405) CFSTI: $3.00

Principles and methods of rational thermodynamics are discussed with a view towards applying them to fast flows of compressible fluids and to the conformal mapping of diffusers and jet pipes. Included are discussions on the origins of thermodynamics, Mayer's principle, Carnot's principle, differential relations, principal specific heats and differential relations, the fundamental theorem and the equation of state concept, the precise form of the equation of state according to hypothesis, thermodynamic systems, the paradox of the piston stroke, and the steady Joule–Thomson flow. R.N.A.

N66-16930# European Atomic Energy Community, Brussels (Belgium).
OPTIMIZATION OF HEAT PIPE THERMIONIC CONVERTERS FOR SPACE POWER SUPPLIES
C. A. Busse 1965 20 p refs
(EUR-2534.e) CFSTI: HC $1.00/MF $0.50

A relation for the electrical power output of a cylindrical hear pipe thermionic converter is derived, taking into account ohmic losses in emitter, collector and lead wire. The maximum electrical power output is determined for a given specific mass of the converter, emitter radius and lead wire length by optimizing the load voltage, the length of the emitter and the cross sections of emitter, collector and lead wire. The electrical power which can be generated with a single converter unit, is limited by the tolerable specific mass and diameter of the emitter; large power outputs necessitate large specific masses and/or large diameters. The bulk properties of emitter, collector and lead wire material enter into the relation for the maximum electrical power output only as the product of electrical resistivity and mass density. The power output is higher the smaller each of these products is. The electrical power output of the converter differs from the power output of an ideal converter with zero electrical resistivities by Joule losses and shift losses. The efficiency of the converter reaches values of up to about 75% of the efficiency which would be obtained in case of no thermal losses through the lead wire and of zero electrical resistivities of emitter, collector and lead wire.
Author

N66-16949# Emerson Electric Mfg. Co., St. Louis, Mo.
PROPERTIES OF "THERMO-LAG" T-500 EX 167 SUBLIMING COMPOUND
[1965] 181 p
(Rept.-1139)

Thermodynamic and physical properties are described for a subliming compound, which can be used for cooling of hypervelocity escape, reentry, and ballistic vehicles. Mixed and applied like a paint, the compound sublimes at a predesigned temperature, bonds well to clean laminate and metallic surfaces, does not deteriorate in storage, and is a highly efficient heat blocker. A thermal model is used to define the basic problem requiring a true sublimer, that is, a material whose sublimation temperature is independent of heat flux. A summary, as well as detailed reports, of its properties; and method of data reduction and data sheets are included. M.W.R.

N66-16959# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF CONTROLLING THE PRESENCE OF SPRAY
E. A. Abov and A. N. Starkov 7 Oct. 1965 8 p Transl. into ENGLISH from Soviet Patent No. 167269 (Appl. No. 827995/24-6, 30 Mar. 1963) 1 p
(FTD-TT-65-1112/1+4; AD-473492)

Methods are known of controlling the presence of spray in chambers, for instance in the combustion chambers of gas turbines, with respect to the electrical conductivity of the spray itself. They consist of introducing electrodes into flames which are connected with a relay-amplifier which fixes the conductivity of the flame which is generated under the effect of high temperatures. The presents a high reliability and enables us to control the presence of spray of practically any intensity. The essences of the method consist in the fact that the electrical conductivity of spray is used as the element of connecting the electronic relay-amplifier with a source of electric or electromagnetic signal. Thereby the spray is a peculiar antenna, its connection with the electrode of the relay-amplifier can be both by direct contact and by electrical capacitance of the electrode-spray system without direct contact with the high-temperature zone of the spray. Author (TAB)

N66-16966# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTATION OF TEMPERATURE FIELDS AND STRESSES IN THE COOLED ROTOR OF A GAS TURBINE ON STARTING
S. A. Mokrushin and Ya. M. Gusak 24 Nov. 1965 22 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 7, 1964 p 11–15
(FTD-TT-65-1028; AD-624852) CFSTI: HC $1.00/MF $0.50

A method is presented for the calculation of temperatures and stresses in the disks of gas turbines on starting, by means of a universal program for the Ural-1 electronic digital computer. Author (TAB)

N66-17008# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
THE EFFECTS OF MASS-TRANSFER ON THE DYNAMIC STABILITY OF SLENDER CONES
Donald D. Colosimo Nov. 1965 59 p refs
(CAL-141; AD-624433) CFSTI: HC $3.00/MF $0.75

An exploratory analytical and experimental investigation of the effects of the mass-transfer of an ablating engineering material on the dynamic stability of Teflon models slender vehicles in hypersonic flow was initiated. These data obtained with the ablation of engineering materials were compared to data obtained with blowing techniques and very low temperature sublimers. In this comparison of dynamic stability data with mass-transfer, no consistency is discernible among the data obtained with the different methods of mass addition. An attempt to generate empirical values for the boundary layer terms in the theory indicates that present theoretical analyses of the stability of slender vehicles including viscous effects have not yet been perfected. Author (TAB)

N66-17045*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WALL AND BOTTOM HEATING OF LIQUID HYDROGEN IN A PROPELLANT TANK
Sidney C. Huntley, James W. Gauntner, and Bernhard H. Anderson Washington, NASA, Feb. 1966 35 p refs
(NASA-TN-D-3256) CFSTI: HC $2.00/MF $0.50 CSCL 20M

An experimental investigation was made to determine the behavior of liquid hydrogen in a 125-gallon scale model of a propellant tank subjected to a range of wall heat flux from 0.0012 to 0.0082 Btu per square foot per second and a range of bottom heat flux from 0.0005 to 0.0098 Btu per square foot per second while discharging from the tank at a rate of 0.04 pound per second under a constant tank pressure of about 2 atmospheres. Increasing temperature stratification in the liquid was encountered with increasing wall heat flux; a decrease in stratification was experienced with increasing bottom heat flux. An available analysis partially predicted the increase in temperature stratification. Generalization of the exit temperature histories showed that the data were applicable to other test conditions provided similarity existed in the normalized heat input rate distribution. Application of the generalization method to other test data showed that bottom heating gave results similar to nuclear heating from below which had a similar overall heat input rate distribution. No gross changes in liquid behavior were experienced over the range of experimental conditions. Author

N66-17122# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF THE OPTIMUM DIMENSIONS OF RADIATING FINS
O. Yu. Kovosel'skiy and V. L. Ukolov 24 Nov. 1965 12 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), no. 12, 1964 p 54–59
(FTD-TT-65-1032/1+2+4; AD-624850) CFSTI: HC $1.00/MF $0.50

A system of equations of radiation heat transfer from a finned tube under conditions of a uni-dimensional problem is solved. An approximation method of determining the optimum dimensions of flat fins under boundary conditions on the inner surface of the tube is carried out. Author (TAB)

N66-17171# Kansas Univ., Lawrence. Dept. of Chemistry.
THERMODYNAMICS OF MATERIALS AT HIGH TEMPERATURE AND LOW PRESSURE
Paul W. Gilles 24 May 1965 23 p refs Presented at the Intern. Conf. on Appl. of Fundamental Thermodyn. to Met. Processes, Pittsburgh Univ., 29 Nov.–1 Dec 1964 Submitted for Publication
(Contract AT(11-1)-1140)
(COO-1140-123; CONF-641124-1) CFSTI: HC $1.00/MF $0.50

A discussion is presented of some of the principles of vaporization phenomena and how they are related to the thermodynamic properties of substances. Some possible purposes of vaporization studies are outlined. Pressure-composition diagrams are discussed with the diagrams of Ti–O, Ti–S, and U–S as examples. Some of the various factors influencing vaporization phenomena are considered, and the stages of a vaporization study are described. NSA

N66-17216*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TOTAL THERMAL CONDUCTIVITY OF PARTIALLY AND FULLY IONIZED GASES
Warren F. Ahtye [1965] 10 p refs Submitted for Publication
(NASA-TM-X-56059) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The total thermal conductivity of ionized gases within the framework of the Chapman–Enskog formulation was calculated, based on the expression for the heat flux vector. In this report, the forcing potential was found directly by making use of the conservation of the net flux. Physically, this means that an arbitrary value of the charge separation field will result in a readjustment of the concentration gradients so that the net flux is conserved. The conservation of fluxes of ions and electrons requires that the diffusion velocities of the ion and electron be identically zero. Expressions for diffusion velocity and the forcing potential are thus obtained. By substitution, the heat flux vector, and then the total thermal conductivity were expressed in terms of known quantities. The approach was then extended to partially ionized gases and to a ternary plasma. N.E.N.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N66-16266# Joint Publications Research Service, Washington, D. C.
HELIOTECHNOLOGY
3 Jan. 1966 59 p refs Transl. into ENGLISH from Geliotekhn. (Tashkent), no. 2, 1965 p 5–56
(JPRS-33571; TT-66-30016) CFSTI: $3.00

Collections of NASA Documents

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1. THE EFFECT OF IMPURITIES ON SILICON PHOTOCELLS M. S. Saidov, A. Arifov, M. R. Akhmedzhanov, and I. Sultanov p 1–4 refs (See N66-16267 07-03)

2. MEASURING THE DISTRIBUTION OF LIGHT IN THE FOCAL SPOT OF SOLAR COLLECTORS V. B. Veynberg, G. Ya. Konayeva, and D. K. Sattarov p 5–10 refs (See N66-16268 07-23)

3. EXPERIMENTAL STUDY OF EFFECT OF INACCURATE ORIENTATION OF SOLAR MIRROR DEVICE ON ITS POWER CHARACTERISTICS R. A. Zakhidov and D. I. Teplyakov p 11–18 refs (See N66-16269 07-03)

4. EXPERIMENTAL MANUFACTURING OF PARABOLOID GLASS-PLASTIC COLLECTORS E. B. Rubinov, G. Ya. Umarov, E. A. Pinkhasov, A. Ya. Bashnyak, and A. Abduazizov p 19–23 refs (See N66-16270 07-18)

5. BAND FACET COLLECTORS A. Sh. Sharafi and G. A. Kleyn p 24–26 ref (See N66-16271 07-03)

6. RAISING THE RESISTANCE OF POLYAMIDE FILMS TO LIGHT G. A. Kleyn, A. N. Filippov, G. A. Adilkhodzhayeva, R. N. Alimova, and T. Sh. Khalmetova p 27–30 refs (See N66-16272 07-18)

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8. A CIRCULATING SOLAR WATER DISTILLER A. Sh. Sharafi p 34–36 ref (See N66-16274 07-11)

9. THE EFFECT OF CONCENTRATED WHITE AND MONOCHROMATIC RED, GREEN, AND BLUE SOLAR LIGHT ON PLANT GROWTH, DEVELOPMENT, AND YIELD S. A. Stanko p 37–43 refs (See N66-16275 07-04)

10. STUDY OF SOLAR RADIATION FALLING ON SCHOOL BUILDINGS T. I. Shapalova p 44–48 refs (See N66-16276 07-29)

11. COEFFICIENT OF REFRACTION OF POLYETHYLENE TEREPHTHALATE FILM N. V. Kordub p 49–50 refs (See N66-16277 07-18)

12. ON COMPUTING THE OPTIMUM EFFICIENCY OF A SOLAR THERMOELECTRIC GENERATOR B. Arazmedov p 51–53 refs (See N66-16278 07-03)

N66-16306# Federal Council for Science and Technology, Washington, D. C.

COMMITTEE ON SCIENTIFIC AND TECHNICAL INFORMATION. RECOMMENDATIONS FOR NATIONAL DOCUMENT HANDLING SYSTEMS IN SCIENCE AND TECHNOLOGY

Nov. 1965 608 p refs With Appendix A, Vol. I and II (PB-168267; AD-624560) CFSTI: HC $3.50/MF $2.75

The report contains recommendations for a national document-handling system in science and technology. Problems in the scientific and technical information and document area are considered, and a set of principles and requirements for a national system are presented. The preferred system and four alternative approaches are developed and evaluated.

TAB

N66-16806# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS OF COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 278

17 Jan. 1966 217 p refs Transl. into ENGLISH from K'o Hsueh T'ung-Pao (Peking), no. 11, 1965 p 941–1034 (JPRS-33759; TT-66-30202) CFSTI: $6.00

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2. RESEARCH ON SOLAR ACTIVITIES Ch'en Piao p 12–19 refs (See N66-16807 07-29)

3. CURRENT CONDITIONS OF THE STUDY OF GEOMECHANICS T.-c. Sun and C.-h. Chen p 20–38 ref (See N66-16808 07-13)

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5. SEVERAL PROBLEMS CONCERNING THE PHYSIOLOGICAL MECHANISM OF MEMORY Jih-ch'ang Ts'ao p 56–63 refs

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7. DEVELOPMENTS IN RESEARCH ON SB-58 TREATMENT OF SCHISTOSOMIASIS JAPONICA Jih-kuang Hsu and Ming-kang Ch'en p 73–89 refs

8. MICROCRYSTALLINE GLASS C.-c. Li p 90–103 refs (See N66-16810 07-18)

9. THE CATALYSTS BASED ON TITANIUM TETRA-N-BUTOXIDE TO POLYMERIZE BUTADIENE INTO POLYMER WITH CIS-1,4 CONFIGURATION Hung-ch'uan Hsieh and Chiu-mien Wen p 104–112 refs

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12. DISCOVERY OF A NEW VARIETY OF DRAVITE AND ITS SIGNIFICANCE FOR MINERALOGY Hsiu-chang Wang and Hsueh-yen Hsu p 129–137 refs

13. TRANSMISSION CHARACTERISTICS OF THE ND^{3+} LASER F.-h Kan, Y.-s. Ts'ai, C.-h. Chiang, H.-s. Li, and C.-f. Li p 138–151 refs (See N66-16812 07-16)

14. ELECTRON TEMPERATURE AND DENSITY INSIDE A GAS DISCHARGE TUBE C.-c. Lin, H.-h. Ch'en, and Y.-s. T'ang p 152–160 refs (See N66-16813 07-25)

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18. UTILIZATION OF INDUSTRIAL DISCARDS TO MANUFACTURE NEW CONSTRUCTION MATERIALS Ch'eng-tsu Ch'u p 174–181

19. SECOND ALL-CHINA GLASS FIBER SYMPOSIUM p 182–187

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N66-16817# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 275

10 Jan. 1966 32 p refs Transl. into ENGLISH from Chinese periodicals (JPRS-33661; TT-66-30105) CFSTI: HC $2.00

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1. THE SHANGHAI OBSERVATORY L. Heng and H.-c. Tsou p 1-7 (See N66-16818 07-30)

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4. ANNOTATED TABLE OF CONTENTS, CHINESE COMMUNIST JOURNAL ON GEOLOGY [GEOLOG. REV., VOL. 23, NO. 1, JAN. 1965] p 24-26

N66-17047*# International Business Machines Corp., Rockville, Md. Federal Systems Div.

ORL EXPERIMENT PROGRAM, VOLUME B. PART I: AGRICULTURE/FORESTRY

21 Feb. 1966 148 p ref

(Contract NASw-1215)

(NASA-CR-70350) CFSTI: HC $4.00/MF $1.00 CSCL 02

A framework for synthesizing an experiment program for Orbiting Research Laboratories (ORL) is applied to the agriculture/forestry scientific and technical area. The objective of this area is to increase the output of food, fiber, and forest products. Consideration is given to the identification of selected knowledge requirements and the derivation of experiment requirements. These include equipment functional and supporting research requirements, and prospective orbital activities. Appendices include illustrations and identifications of knowledge requirements, and discussions of representative experiments. C.T.C.

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